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ABSTRACT

This activity guide is designed to develop students' understanding of the interdependence of people and the environment as well as the interdependence connecting members of the global family. It is both an environmental education curriculum and a global studies resource suitable for middle school science, social studies, math, language arts, and family life education classrooms. The readings and activities contained in this book are designed to broaden students' knowledge of trends and connections among population change, natural resource use, global economics, gender equity, and community health. This knowledge combined with the critical thinking skills developed in each activity will help students explore their roles as global citizens and environmental stewards. The book is divided into four parts: (1) Understanding Population Dynamics; (2) People, Resources, and the Environment; (3) Issues for the Global Family; and (4) You and Your Community. Also included is a list of activities grouped by themes including air/water pollution and climate change, carrying capacity, environmental and social ethics, family size decisions, future studies, land use issues, natural resource use, population dynamics and trends, resource distribution/inequities, solid waste management, and sustainability. The appendices contain sources for further research and population education materials. (JRH)

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People and the PLANET

Lessons for a Sustainable Future

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People and the PLANET:

Lessons for a Sustainable Future

Edited by Pamela Wasserman

Zero Population Growth, Inc.
Washington, DC

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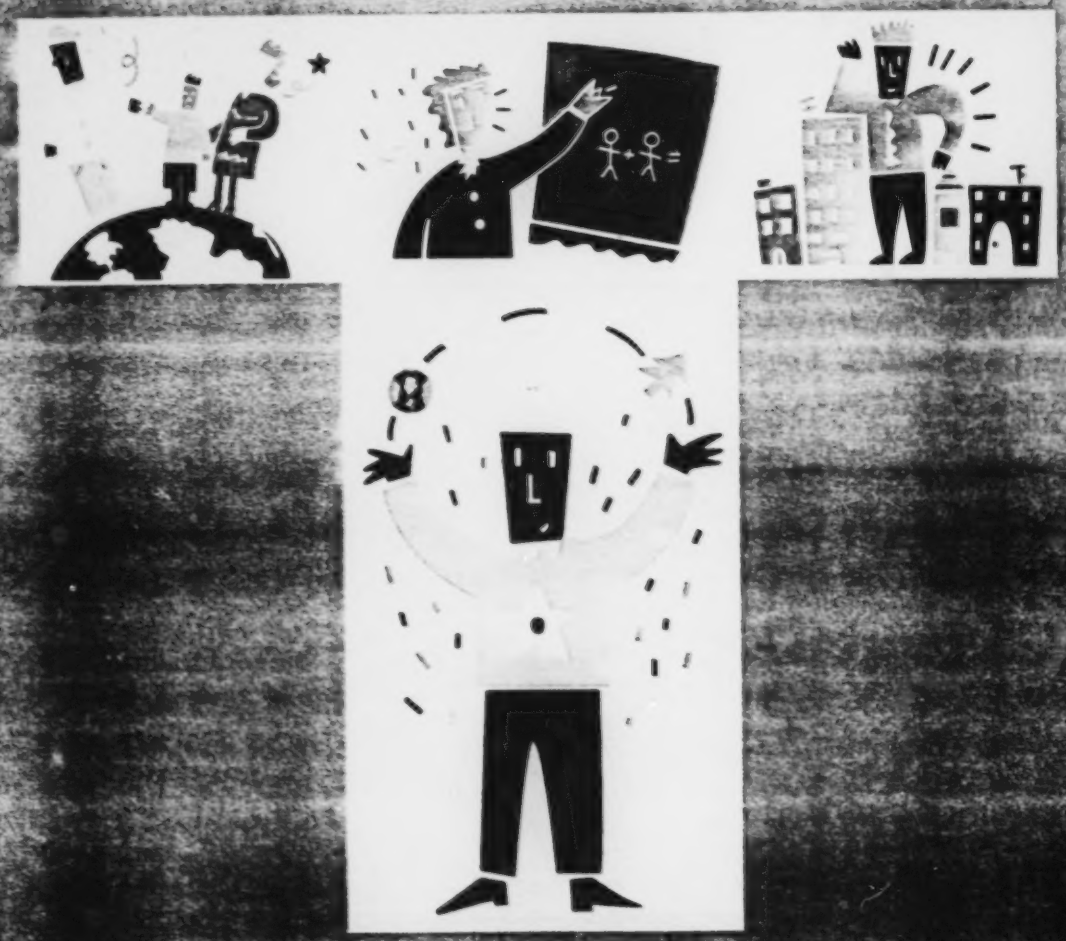

Teachers Guide

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TEACHERS' GUIDE
People and the Planet

Welcome to *People and the Planet: Lessons for a Sustainable Future*, an activity guide that develops students' understanding of the interdependence of people and the environment, as well as the interdependence connecting us with other members of our global family. This interdisciplinary resource is both an environmental education curriculum and a global studies resource suitable for the middle school science, social studies, math, language arts and family life education classroom.

What's So Important About People and the Planet?

As of this printing, the planet is home to nearly six billion people and counting. This is twice the population of 1960. The recent and rapid growth in the size of our global family is intricately linked to many of the environmental and social trends of our present society: strains on our natural resources, diminishing open space for wildlife habitat and recreation; polluted air and water; climate change; unprecedented world-wide communication and trade; an increase of people living in poverty; and great migrations of people within and between countries.

In response to these trends, people are asking themselves, "What do we want our future to be like?" "What do we want our communities to look like?" and "How do we provide for the best quality of life for present and future generations?" At the core of these questions is the concept of *sustainability* – providing for people's present needs while not compromising the ability of future generations to meet their needs. Helping humankind to thrive in the 21st century requires that we recognize the importance of living in balance with our physical environment and treating each other with dignity and equity.

Today's students will be tomorrow's leaders, parents and professionals. Their decisions as young people and adults form the environmental and social trends that shape our society. The readings and activities in *People and the Planet* are designed to broaden their knowledge of trends and connections between population change, natural resource use, global economics, gender equity and community health. This knowledge, combined with the critical thinking skills developed in each activity, will help students explore their roles as global citizens and environmental stewards.

How to Use this Book

People and the Planet was designed with a number of teaching options in mind. It can be used as an entire curriculum on human communities and the environment, or specific activities can be used on their own. Activities and readings can be used in a single discipline or team taught with colleagues in other subject areas.

Subject Areas:
All of the activities in *People and the Planet* are interdisciplinary, drawing on skills for science, social studies, math, language arts and family life education. A few even develop skills in the visual and dramatic arts. The matrix on page xiii lists which activities are applicable for each subject area. Subjects are also listed on the first page of each activity in a colored box. The activities are appropriate for both formal and nonformal environmental studies.

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Grade Level:
While the activities are designed for students in middle school, they can be easily adapted for use with younger and older students. Given that students work at different levels within each grade designation, *People and the Planet* is recommended for teachers of grades 5-10, depending on the student group. Additionally, the concepts and hands-on teaching methods may be useful in adult education classes including English for Speakers of Other Languages (ESOL).

Teaching Techniques:
Because educators employ different styles and techniques to help students absorb the information, the activities in *People and the Planet* include a variety of teaching strategies. All of the activities are hands-on and thought-provoking. Many of them will provide memorable learning experiences that your students will talk about for weeks after participating in the activities. The methods employed in the 30 activities include role-playing simulations, science labs, graph/chart creation and analysis, concept mapping, word problem solving, library research, event planning, debate and reading comprehension. The colored box on the first page of each activity explains the teaching methods that are used.

Student Readings:
Each of the book's four parts begins with a student reading. This reading provides an overview of the topics covered in the activities that follow. They also include relevant charts and illustrations. These readings are to be photocopied and distributed to each student. Depending on the students' reading proficiency, you may wish to assign these articles for independent reading, have students take turns reading aloud paragraphs during class, or paraphrase the material for your students. While the readings are written with middle school students in mind, they also provide background information for the teachers that can be incorporated into the introductions of various activities. As a measure of reading comprehension, each reading concludes with questions for the students. A glossary of new and difficult words is also listed for students.

Organization:
People and the Planet is divided into four parts. Part 1 (Understanding Population Dynamics) introduces students to the history of world population, how populations grow, exponential growth, demographic profiles of different countries, and the role of individual decision making in determining population growth rates. Part 2 (People, Resources and the Environment) explores the relationship between population and resource consumption trends, and the collective impact these trends have on the health of different ecosystems. Topics covered in Part 2 activities include loss of biodiversity; the use of land, water, energy, forests and minerals; cars and their environmental impacts; waste management; and personal environmental ethics. Part 3 (Issues for the Global Family) explores the connections between population growth, social justice and people's quality of life worldwide. Issues addressed include distribution of wealth, hunger, gender equity and international migration. Finally, Part 4 (You and Your Community) brings all of these issues back home to the local level. Activities spur discussion on planning for sustainable communities and envisioning a future for people and the planet.

Activities Grouped by Themes:
For guidance on groups of activities within *People and the Planet* that can be combined for thematic learning, such as units on natural resource use or population dynamics, refer to suggested "Activities Grouped by Theme" on page xii.

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Outcome-based Objectives:
Each activity clearly outlines 1-5 measurable objectives for the students. These might include defining terms; creating graphs and concept maps; writing essays, letters, poems and resolutions; solving word problems; recording observations; and conducting surveys. All of the activities include discussion questions to stimulate critical thinking and assess students' understanding of the activity concepts.

Materials:
All of the needed materials are listed in the colored bar on the first page of each activity. Most of the items listed are common classroom and household materials. Wherever "Student Worksheet" is listed under "Materials," a master of the worksheet is provided within the activity and should be photocopied for each student.

Additional Resources:
People and the Planet is a thematic curriculum, exploring connections between people and the environment in its largest context. For more in-depth background information and teaching materials on some of the specific topics addressed, refer to the list of organizations at the end of the book. A few of the activities also recommend supplemental materials to enhance the lessons.

ZPG: Over Two Decades of Educational Programs

We hope that you and your students enjoy using *People and the Planet*. Since 1975, ZPG's Population Education Program has developed quality teaching materials for the K-12 classroom and has offered teacher training sessions for conferences, staff development and preservice methods classes. For a catalog of our teaching materials, free subscriptions to teacher and student newsletters, free fact sheets and teacher training schedules, please contact: ZPG Population Education Program, 1400 16th Street, N.W., Suite 320, Washington, DC 20036; (202) 332-2200 or 1-800-POP-1956. Visit our site on the World Wide Web: http://www.zpg.org. We welcome your questions, comments and suggestions.

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Activities Grouped by Themes

Air/Water Pollution and Climate Change

If Money Won't Buy It ...
Transportation Tally
Water, Water, Everywhere

Carrying Capacity

Cougar Hunt
The More the Merrier?
The Stork and the Grim Reaper
World Real Estate

Environmental and Social Ethics

Eco-Ethics
Educating Wanjiku
Food for Thought
For the Common Good
The Hunger Banquet
Take a Stand

Family Size Decisions

Family Perspective
Stage Stepping

Future Studies

Everything Is Connected
In Search of Sustainable Life
Looking to the Future

Land Use Issues

Growing Pains in Texas Hill Country
Stash the Trash
Treasures Underground
A World of Difference
World Real Estate

Natural Resource Use

For the Common Good
If Money Won't Buy It ...
Timber!
Transportation Tally
Treasures Underground
Water, Water, Everywhere
A World of Difference

Population Dynamics and Trends

Family Perspective
Measuring a Million
The More the Merrier?
On the Double
Power of the Pyramids
Seeing Double
The Stork and the Grim Reaper
Stage Stepping

Resource Distribution/Inequities

Food for Thought
For the Common Good
The Hunger Banquet
People on the Move

Solid Waste Management

Market Research
Stash the Trash
Waste Not, Want Not

Sustainability

For the Common Good
Growing Pains in Texas Hill Country
In Search of Sustainable Life

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SUMMARY OF ACTIVITIES

ACTIVITIES	DESCRIPTION	SUBJECTS	SKILLS
1. The More the Merrier?	Students demonstrate the effects of crowding in a "jumping jack" activity and then discuss the pros and cons of population density.	Social Studies Math Science	Observing, brainstorming, critical thinking, using reference materials
2. Measuring a Million	Through riddles and a cooperative learning math assignment, students calculate and visualize millions and billions of things and people.	Math Science	Calculating, estimating, measuring lengths/areas/volumes, averaging, using the metric system
3. Seeing Double	Riddles and a laboratory activity using fruit flies reinforce students' understanding of exponential growth patterns.	Math Science	Problem solving, multiplying, counting, observing
4. The Stork and the Grim Reaper	In a short demonstration using colored water and measuring cups, students observe how populations grow when birth rates exceed death rates.	Social Studies Science Math	Observing, critical thinking, calculating with fractions
5. On the Double	Students use math formulas to calculate the growth rates and doubling times for the populations of different countries.	Math Science Social Studies	Calculating percentages and doubling times
6. Power of the Pyramids	Students construct and interpret population pyramids and discuss differences in age and gender distribution among several different countries.	Math Social Studies Science	Calculating percentages, graphing, analyzing and interpreting data
7. Stage Stepping	Students simulate several generations of a family's growth, comparing a two-child and three-child average family size.	Math Social Studies Family Life Ed.	Simulating models, looking for patterns, constructing a bar graph, critiquing models
8. Family Perspective	Students survey family-size trends over the past three generations and participate in a brief simulation illustrating how gender sometimes determines family-size decisions.	Math Family Life Ed. Social Studies Science	Calculating averages and probability, rounding numbers, gathering data, graphing, critical thinking, identifying trends

SUMMARY OF ACTIVITIES

ACTIVITIES	DESCRIPTION	SUBJECTS	SKILLS
9. Cougar Hunt	Students explore the concept of carrying capacity when they act as predatory animals in a finite area and attempt to accumulate enough food to stay alive.	Science Math Social Studies	Observing, understanding cause and effect, adding, role playing, using metric system
10. World Real Estate	Students observe a demonstration of world land use with an apple representing the Earth, and determine approximately how much of the Earth's surface is land used to grow food crops to support the population.	Science Math Social Studies	Estimating, calculating percentages, dividing, graphing, critical thinking
11. Everything Is Connected	By creating a concept map, students identify ways that many factors in human society and the natural environment are interdependent.	Science Social Studies	Drawing connections, explaining cause and effect, working in cooperative groups, concept mapping
12. A World of Difference	Through a simple simulation with dry beans and follow-up discussion, students learn what is meant by "biodiversity," why it is important and the impact human population growth can have on it.	Science Math Social Studies Art	Observing, counting, analyzing data, critical thinking, researching, visual arts
13. Timber!	In this role-playing simulation using popsicle sticks, students observe what happens to a forest when the demand for wood exceeds the supply.	Math Science Social Studies Language Arts	Adding, subtracting, working in cooperative groups, interpreting data, poetry writing
14. Water, Water, Everywhere	Students observe a brief demonstration on the distribution of the world's water and then calculate how much water they use on a daily basis.	Science Math Family Life Ed.	Estimating, graphing, calculating, metric measuring, observing, researching, writing
15. Transportation Tally	Students assess the natural resource use, pollution and community impacts associated with our population's driving habits through a series of math word problems, and develop suggestions to meet the transportation challenges of the future.	Math Social Studies Science	Analyzing data, identifying problems, brainstorming, multiplying, dividing, comparing numbers, calculating growth rates, converting units of measure

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SUMMARY OF ACTIVITIES

ACTIVITIES	DESCRIPTION	SUBJECTS	SKILLS
16. If Money Won't Buy It...	As an exercise in critical thinking, students set priorities for their energy use and lifestyle choices when they can only spend a limited amount of "natural resource units."	Math Science Social studies	Adding, subtracting, interpreting data, problem solving, decision making, critical thinking
17. Treasures Underground	Students investigate the mineral content of everyday items in a matching activity and simulate mineral extraction using a toothpick and a chocolate chip cookie.	Science Social Studies Math	Drawing connections, using fine motor skills, brainstorming
18. Stash the Trash	Students construct a miniature sanitary landfill and identify the advantages and disadvantages of disposing of solid waste by this method.	Science Math	Collecting and analyzing data, understanding cause and effect, brainstorming, calculating, observing, preparing a lab
19. Market Research	Students visit the supermarket after an introduction to the principles of supply and demand. There they determine how these principles can be put to use in making environmentally sound decisions in grocery shopping.	Science Math Social Studies	Collecting and interpreting data, understanding cause and effect, researching
20. Waste Not, Want Not	Students find ways to reuse household items in an activity that turns trash into school supplies and in the planning of a no-waste party.	Science Social Studies Language Arts	Critical thinking, brainstorming, creative writing
21. Eco-Ethics	While considering various dilemmas presented, students examine their own values and beliefs related to environmental issues, and evaluate possible actions they might take that have an impact on the environment.	Science Social Studies Language Arts	Decision making, critical thinking, writing, values clarification
22. Food for Thought	Students participate in a global simulation game that illustrates the inequitable distribution of population, wealth and resource use among the different world regions.	Social Studies Science Math	Interpreting and analyzing demographic data, role playing, drawing connections
23. The Hunger Banquet	Students participate in a luncheon-game that simulates inequities in the global distribution of food and wealth.	Social Studies Family Life Ed.	Communication, bargaining, conflict resolution, strategic planning, writing

SUMMARY OF ACTIVITIES

ACTIVITIES	DESCRIPTION	SUBJECTS	SKILLS
24. For the Common Good	In a simulation game, students desiring to draw renewable resources from a common pool determine short-term consumption strategies that will preserve a long-term supply of the resource.	Social Studies Science Language Arts	Finding cooperative strategies, following directions
25. People on the Move	Students participate in a brief simulation and discussion that help them to identify some of the reasons that encourage people to migrate from one place to another.	Social Studies	Observing, critical thinking, inductive reasoning, sharing experiences, problem solving
26. Educating Wanjiku	Students read a short story about the education of girls in Kenya, and then answer comprehension and critical thinking questions about the status of women and girls in developing countries.	Social Studies Language Arts	Critical thinking, reading, brainstorming, interpreting graphs
27. Growing Pains in Texas Hill Country	Students examine the impact of population growth and urban sprawl on communities when they read an article about local growth in a Texas community, role play in a city council debate, and draft resolutions to encourage or discourage further growth.	Language Arts Social Studies Dramatic Arts Science	Critical thinking, reading, writing, role playing
28. In Search of Sustainable Life	Through class brainstorming and a cooperative learning activity, students develop an index of what they consider to be the ten most important indicators of a healthy community.	Social Studies Science	Values clarification, communication, brainstorming, visualization, decision making, prioritizing, critical thinking, problem solving, writing
29. Take a Stand	Students articulate their thoughts about the ethical issues related to population and the environment, and consider the opinions of their classmates in this informal debate.	Social Studies Science Language Arts Family Life Ed.	Values clarification, communication, discussion
30. Looking to the Future	In creating a futuristic news telecast and a letter to a friend 50 years from now, students think about what their future might look like, given current realities, hopes and dreams.	Science Social Studies Language Arts Family Life Ed.	Summarizing articles, creative writing, visualization

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Understanding Population Dynamics

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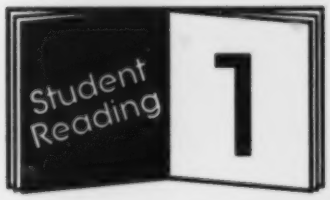
You're One in Six Billion!

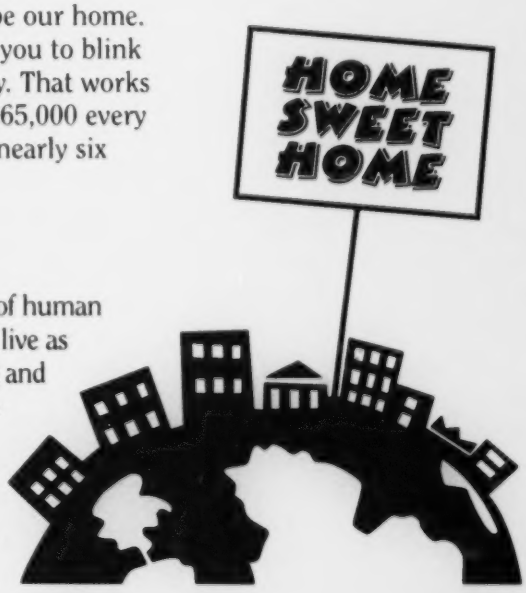


We've all heard the expression, "You're one in a million!" With the ever-growing number of people on the planet, it might be more accurate to say, "You're one in six **billion**!" As humans, we are all part of a giant global family made up of people from all over the world. Although we may look, act and dress differently, each person shares the same basic needs and hopes for the future. When the **population** of our global family grows, it becomes more difficult for our home (planet Earth) to meet everyone's needs and wants.

Think of your own home and family. What if your family continued to grow but remained in the same house or apartment? What sort of things might change in the way you live? What are some things you would need more of in your home? For starters, you would need more food, beds, clothes and energy to heat water for showers and power all of the appliances that would be used more often. You would also need more cooperation because each person would have less privacy and personal space.

If your family grew, you might decide to build on to your house or move to a bigger house or apartment. When the global family grows, there is no bigger planet on which to move. Earth is the only planet where humans can live and it is a **finite** system. We can never increase the number of oceans or mountains on Earth. None of the minerals or oil buried in the Earth can be resupplied. And there is only so much **fertile soil** in which to grow the world's food supply.

We must take care of Earth, because it will always be our home. But our global family grows every day. In the time it takes you to blink your eyes, three more people have been added to the family. That works out to 184 more people every minute, 11,083 every hour, 265,000 every day and over 90 million every year! In fact, our family has nearly six billion (6,000,000,000) people now!



Oh! How We've Grown

How did our global family become so large? For most of human history, the population grew very slowly because people didn't live as long as they do today. Our earliest ancestors relied on hunting and gathering their food to survive. Only a finite number of people could be supported on the wildlife in an area for a limited amount of time. Then, just 12,000 years ago, several cultures shifted from hunting and gathering to farming. Humans became the first and only species ever to control its own food supply. Civilizations grew and so did the human population.

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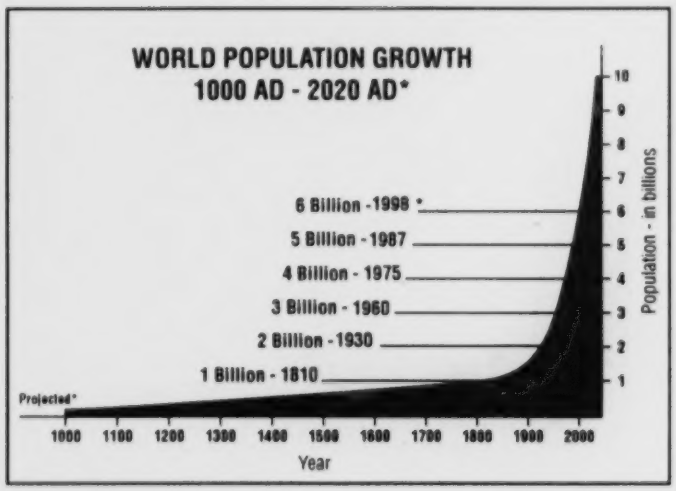
Until recently, **birth rates** and **death rates** were about the same, keeping the population stable. People had many children, but a vast number of them died before age five. Without modern medicine, vaccines and clean, healthy living conditions, many children did not survive common diseases like measles or the flu.

These trends in child deaths began to change with the coming of the **Industrial Revolution**, a period of history in Europe and North America when there were great advances in science and technology. Beginning in the late 1700s, this revolution saw the creation of the steam engine and the use of electricity. During this period there were also many inventions that promoted longer life. These included improvements in farming, nutrition, medicine and **sanitation**. Now, people were able to fight once-deadly germs, produce more and different kinds of food and cure more illnesses. Before long, these new discoveries and inventions spread throughout the world, lowering death rates and improving people's quality of life.



Now you might be wondering what happened to the birth rates while the death rates were coming down. In Europe and North America, the Industrial Revolution eventually led to people having fewer children because more people were now moving to the cities. New farm machinery, such as the cotton gin and wheat thresher, allowed more crops to be harvested in less time with fewer laborers. At the same time, industrialization created more jobs for people in factories and offices in the growing urban centers. But in most of the world, which was less industrialized, large families were still needed to help farm the land and so birth rates stayed higher than death rates. The world population began to grow significantly. By 1930, the world population reached two billion. Just 30 years later, in 1960, the world population hit three billion. The population soared to four billion by 1975, topped five billion in 1987, and will reach six billion in 1998. As you can see, in the scope of human history, this "population explosion" has been fairly recent. Over the past 300 years, the world's population has grown **exponentially**, doubling at an ever-faster rate.

Different populations grow at different rates around the world. This depends on how many children families tend to have and the **life expectancy** (number of years someone is expected to live) of people in different places. The populations of many countries in Asia, Africa and

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Latin America are growing the fastest, especially where large families are still important to parents who need more children to help with family farms and provide for them in their old age. These poorer, **less developed countries** tend to have lower life expectancies and higher **infant mortality rates** (rates of infant deaths). When couples know some of their children may not survive to adulthood, they often choose to have more. In many cases, couples wish to limit their family size, but lack the information and means to make these choices.

While **more developed countries** tend to have slower rates of population growth, some still grow steadily. The United States, for example, is the third most populated country in the world, and grows by nearly three million people each year. That's like adding another Chicago to the nation's population every year!

Those of us who live in small towns or farm areas may not feel that the United States greatly contributes to world population problems. Some argue that population growth in the United States may have more serious environmental impacts than growth in any other part of the world because of "the typical American lifestyle." Each American uses more energy and more water and produces more garbage than a person living anywhere else in the world. We make up 5% of the world population, yet use up more than 20% of the Earth's natural resources. Because of this, even modest increases in population in the United States have far-reaching impacts for all members of the global family.

What's the Big Deal?

OK, so the population of the planet is growing and there are already about six billion of us. Is this something we should care about? Yes. Can the world population keep growing without end? No. When it comes to population, bigger isn't always better. Every population, whether it's of plants, animals or people, has a **carrying capacity**. This is the maximum number of a species that can be supported by the finite resources available. Think of a wooded area that is home to deer, rabbits and squirrels. There is only enough food to be found for so many animals. If the populations of these animals grow too much, some may have to leave to find other food and shelter. The wooded area has a carrying capacity — it can only support so many animals.

The same is true for people. It may seem like there's plenty of room to go around in this big world of ours. But we need to remember that when the number

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of people doubles, a lot of other things grow or shrink. With every new person added to the planet, the need for food, shelter, clothes and fuel grows. More people also demand more cars, roads, schools, hospitals, restaurants and stores. Even as our demands grow, the ability of our world to meet those demands shrinks. More buildings mean cutting more trees for lumber, burning more fuel for energy and using up land that may have been home to different plants and animals. There is only so much land on our planet to grow food, plant trees, build cities and still leave space for animals and plants to grow in the wild. If there are too many people, there may not be enough of some of the things we need for everyone to have a share.

What Can Be Done

Population growth rates come down when couples choose to have fewer children. Throughout the world, birth rates have been gradually dropping as people receive education on how to plan their families. People everywhere are learning the economic and health benefits of waiting until they're older to have children and then spacing their births by several years — two factors that slow the population growth. If the average family size throughout the world were two children and two parents, the world's population would be at a stable level (also known as **zero population growth**). Your parents and teachers are the best sources of information on when and how to plan a family.

The problem for our planet isn't just numbers of people, though. In looking to protect Earth's natural beauty and keep enough natural resources for the future, we must also take care to use resources carefully and to be considerate of the needs of others. Resource conservation means making thoughtful choices about the way we use energy, eat, travel and create waste. The decisions each person makes go a long way to making our planet a more comfortable home for the global family.

Reading Comprehension and Analysis:

1. By how many people is the world population growing each year?

2. Why is the world population growing faster now than it did hundreds of years ago?

3. What is meant by "the Earth's carrying capacity to support humans"?

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Glossary:

billion: quite a large number (1,000,000,000). A billion is a thousand times as large as a million. It would take 95 years to count a billion dollars if you counted it eight hours each day at the rate of $1 each second.

birth rates: the yearly number of births per 1,000 people.

carrying capacity: the number of people who can be supported at a sustainable level in an area with given resources and technology.

death rates: the yearly number of deaths per 1,000 people.

exponential growth: a growth pattern in which numbers double (multiplied by 2).

fertile soil: soil that is rich in minerals and good for growing crops.

finite: limited amount.

Industrial Revolution: a period in history (mid-18th century through the 19th century) when there was a surge of new technological advances.

infant mortality: the annual number of deaths to infants under one year of age per 1,000 live births in a given year.

less developed countries: poorer countries that do not manufacture as many of their goods as more developed countries.

life expectancy: the average number of years someone is expected to live based on current health trends.

more developed countries: countries with greater overall wealth. These countries tend to be more industrialized, bringing in money from manufacturing more goods.

population: the number of people in a country or region.

sanitation: the prevention of disease and promotion of good hygiene by maintaining clean conditions and safe drinking water.

zero population growth: when a population is stable, neither growing nor decreasing. Globally, this would occur when the birth rate and the death rate are the same.

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ACTIVITY 1

The More the Merrier?

Concepts:
As the population of a region grows, the population density increases. Populations of high density require more cooperation and coordination of activities.

Objectives:
Students will be able to:

- ▶ List situations where population density is an advantage or disadvantage.
- ▶ Find a list of the world's largest cities in an almanac and three facts about one city from other reference sources.

Subjects:
Social Studies, Math, Science

Skills:
Observing, brainstorming, critical thinking, using reference materials

Method:
Students briefly demonstrate the effects of crowding in a "jumping jack" activity and discuss the pros and cons of population density.

Introduction:

Human population growth has a variety of consequences, both direct and indirect. This introductory activity looks at one of those consequences easiest to see in daily life — crowding. With population growth, the average population density will increase, even if the population is denser in some places than others. Visualizing increased population density in a variety of environments can help us plan for the future. For example, in a place already densely populated, an increase can result in more crowding, traffic, waiting in lines, waiting lists, tighter clusters of houses, compact apartments, less space and a general sense of stress. In a mostly unpopulated place, a slight increase in population density can interrupt a previously uninterrupted horizon, reduce or fragment open space, and require new electrical wires and other services.

In the discussion following the brief demonstration, students can weigh the pros and cons of higher population densities. They will explore the services that are enhanced by a higher population density as well as the challenges posed by increased crowding.

Materials:

Masking tape

Procedure:

1. Have students imagine that the number of students in your classroom has doubled. Have them list the effects of this. Make sure that both positive and negative impacts are discussed.

   Answers could include more friends, more ideas, more sharing, less space, crowding, more noise, competition for chairs and books, less attention from the teacher.

2. Have students vote by secret ballot on whether they would like to have more, fewer or the same number of students in the class as they have now. Tally and announce the results to the class.

3. Mark off an area in the classroom with masking tape, chalk or furniture (about a 10 ft. x 10 ft. area). Select two students to stand in the area and do jumping jacks.

4. Keep doubling the number of students doing jumping jacks in the area until it becomes impossible to add more. If you find they have coordinated their arm movements, secretly ask one of the students to get out of synch.

5. Solicit observations from the original pair on how their environment and behavior changed.

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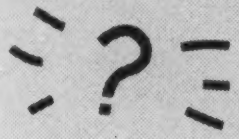
Discussion Questions:



1. Did the students jump in synch? Why did this happen? How did this happen? Does anything like this happen in the real world?

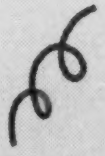
   Coordination of movement is necessary in crowded situations in the real world, too. People get in lines at crowded events, they obey traffic signals and laws, etc.

2. What happened when one person was out of synch? What would happen if that occurred in the real world?

   Have them imagine a person who always disobeyed traffic signals, wouldn't wait his/her turn, or wouldn't share.

3. List situations, events and activities for which it is better to have a lot of people around, and those for which solitude is better.

   Possible activities for large groups include parties, fiestas, family reunions, sports events, competitions, dances, walking on dark streets. It is often less desirable to have big crowds for classes, bicycling, shopping, driving, walking, thinking, drawing, studying, reading, sleeping, waiting for the bus and private conversations.



4. If you had a paper delivery route, would you want it to be in an area with high population density or low population density?

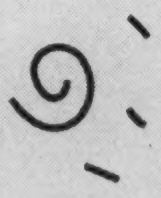
   In highly populated areas it would be easier to deliver more papers in a shorter amount of time, and therefore make more money. If the households were scattered farther apart you might enjoy more fresh air and open scenery on your walk but you would not be able to deliver as many papers before you had to leave for school.

5. What other services are easier to provide for an area of high population density?

   Possible answers might include mail delivery; electricity; telephone, cable, water and sewer connections; door to door sales. Additionally, services centered in one building, like community hospitals, schools, libraries, etc., can be more convenient to people who live close.

6. What qualities are desirable about areas of lower population density?

   Possible answers include more peaceful, open space, more space to plant gardens, fresher air, more nature, less noise, more space to cut loose or to get away.



7. If you had a cold, would more people be likely to catch it where population density was high or low?

   Colds, like other contagious diseases, can pass more easily in areas of high population density. In the densely populated city of Tokyo, Japan, people wear face masks when they have a cold so as not to spread it.

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8. If population continues to grow locally, what is the impact on population density?

If population grows the density will become higher and/or some people may migrate to other areas.

9. Human migration can change the population density of an area relative to neighboring areas, as people move into or out of it. What might make a particular place more crowded and what might make a particular place less crowded, in the long term and in the short term?

Job possibilities, nice retirement areas, healthy climate for allergy sufferers, entertainment and cultural variety, better quality of life and affordable housing are some reasons that areas become more crowded. Places where a major industry goes bust, where civil war breaks out, where job possibilities decline or where taxes are too high, tend to lose people.

Follow-up Activities:

1. This activity shows that population densities impact crowding, amount of open space, delivery of services and contagious disease. As follow-up it is important to discuss the secondary consequences of population density and the idea that populations require more resources than just land area to support them. When population density outstrips the ability of existing local resources to meet the needs of the population, people may want to leave in search of better places. This, in turn, changes the population density of both the place they leave and the new place in which they settle.

2. Have students look in an almanac or atlas for a list of the world's largest cities (such as Tokyo, Sao Paulo, Mexico City or New York). Instruct them to select one of the cities and to find three facts about how population density shapes the lifestyle in that place. They could find this information in an encyclopedia or travel guide. (Example: In Tokyo, the average highway speed is 10 miles per hour due to heavy traffic.)

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ACTIVITY 2

Measuring A Million

Introduction:

There are currently nearly six billion people living on Earth. Most people have difficulty understanding how immense such a figure is. The following riddles and cooperative learning activities help students to represent the number **one million** through mathematical computation. You can then take these exercises one step further by having students visualize and compute formulas for one billion of each object (see Follow-up Activities).

Materials:

Student Worksheets 1-4
4 yard/meter sticks/tape measures
1 Ping-Pong ball
50 sheets of paper
50 sheets of cardstock
Map of the United States

Part 1: Big Riddles

Procedure:

Try these riddles out on your students. For most students, you may want to have them simply guess or give estimates. For mathematically advanced students, you can have them figure out the exact answer.

1. Your rich uncle has just died and has left you $1 billion, with a catch: In order to accept the money, you must count it for eight hours a day at the rate of $1 per second. When you are finished counting, the $1 billion is yours and then you may start to spend it.

   a. Do you accept your uncle's offer? Why or why not?
   No. It would take too long to count the money.

   b. How many years will it take to count the money?
   Over 95 years.

2. a. If you spent $1 million at the rate of $1,000 per day, how long would it take you to spend it?
   1,000 days, or about 2 3/4 years.

   b. How long would it take to spend $1 billion at the same rate?
   1 million days, or 2,739.7 years.

3. a. How old do you think you would be if you were a million seconds old?
   About 11 days old.

   b. How old do you think you would be if you were a billion seconds old?
   About 31 years old.

Concepts:
Millions and billions are huge numbers. To understand the implications of different size populations, it is helpful for students to be able to conceptualize these numbers.

Objectives:
Students will be able to:

- Solve riddles illustrating the difference between millions and billions.
- Complete one of four math problems in a cooperative learning group that require them to measure distance, area or volume of millions (and billions) of items or people.

Subjects:
Math, Science

Skills:
Calculating, estimating, measuring lengths/areas/volumes, averaging, using the metric system

Method:
Through riddles and a cooperative learning math activity, students work through problems to calculate and visualize millions and billions of things and people.

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Part 2: Measuring a Million

Procedure:

Divide the class into four groups. Each group will be responsible for doing one of the following four activities, using the Student Worksheets to guide them. When the activities are finished, have each group present their methods and findings to the other students, who take notes on the presentations.

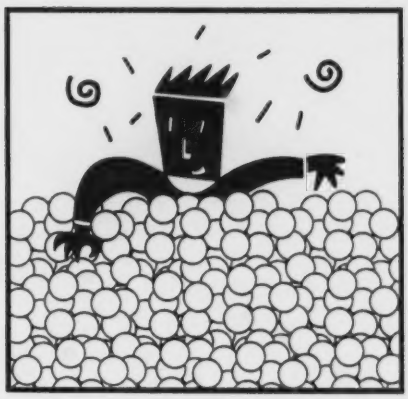
Group #1: How many Ping-Pong balls would fit in the classroom? How big a room do you need to hold a million Ping-Pong balls?

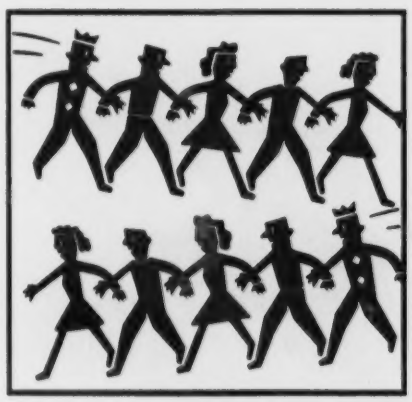
(Note: This group activity is more time-consuming than the other three.)

Group #2: How tall would a million sheets of paper be? What if the paper were cardstock?

Group #3: If you take a million steps, starting from the door of the room, where will you be?

Group #4: Imagine a crowd of one million people. How big a field do you think you would need to contain all of them? If they were marching down the road in single file, how long would the column of marchers be?





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Follow-up Activities:

1. Now that students have a better idea of what is meant by a million, have them take their findings one step further for a billion (1,000 x one million) of each item (Ping-Pong balls, sheets of paper, steps, people).

2. There are nearly six billion people in the world. What would be the length of a row of six billion people?

3. Millions and billions can also be used for solving time problems. Will you be living a million hours from now? How about a billion minutes from now?

Additional Resources:

1. To give students more practice in visualizing large amounts, such as millions and billions of objects, treat your students to *How Much Is A Million?* by David M. Schwartz and illustrated by Steven Kellogg. This colorful book, published by Scholastic, Inc., is available in many bookstores and libraries and contains graphic examples of millions and billions (and even trillions).

   For instance:

   "If a billion kids made a human tower . . . they would stand up past the moon."

   "If a goldfish bowl were big enough for a million goldfish, it would be large enough to hold a whale."

2. Another fun book about numbers of things is *One Million* by Hendrik Hertzberg, published by Times Books. It displays a million dots and entertains with certain "milestones" leading up to one million. (Example: 462,000 is the number of Americans employed in the newspaper industry, whereas 661,071 is the number of Americans named Lee!)

Part 2 adapted with permission from Chicha Lynch, Capuchino High School, San Bruno, CA.

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Name: _____ Date: _____

MEASURING A MILLION
Student Worksheet – Group #1

Problem:

a) How many Ping-Pong balls would fit in the classroom?
b) How big a room do you need to hold a million Ping-Pong balls?

Process:

1. I would estimate that _____ Ping-Pong balls fit in the room.

2. The average estimate of all those in my group is _____.

3. The diameter of one Ping-Pong ball is _____.

4. The length of the room is _____. The width of the room is _____. The height of the room is _____.

5. a) You would need _____(amount) Ping-Pong balls to make a line the length of the room.

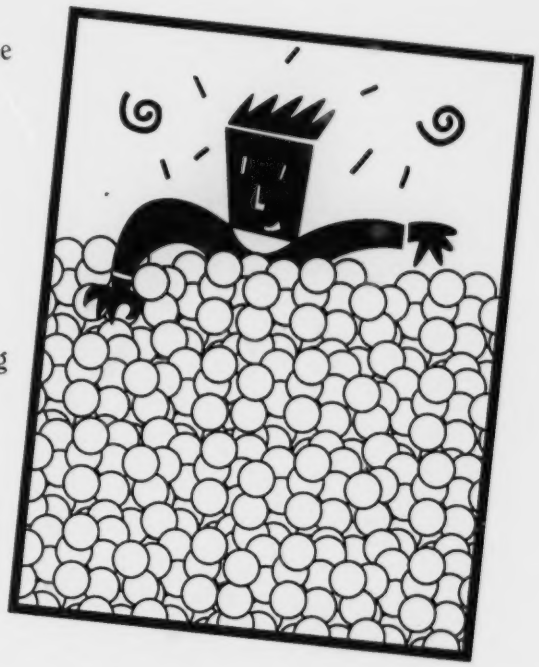
   b) You would need_____ Ping-Pong balls to make a line the width of the room.

   c) You would need _____ Ping-Pong balls to make a line the height of the room.

   d) The dimensions of the room in Ping-Pong balls are _____ x_____ x_____.

6. The volume of a room can be calculated by multiplying the length, width and height together (V=lwh). Therefore, the volume of the room, in terms of Ping-Pong balls, is _____ balls.

7. Write out a plan and calculations for determining the size of a room that will hold a million Ping-Pong balls.



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MEASURING A MILLION
Student Worksheet – Group #2

Problem:

a) How tall would a stack of a million sheets of paper be?
b) How tall would the stack be if the paper were cardstock?

Process:

1. I would estimate that the height of a stack of a million sheets of paper would be _____ centimeters.

2. The average estimate for my group is _____ centimeters.

3. The height of 25 sheets of paper is _____ mm or _____ cm.
   The height of 50 sheets of paper is _____ mm or _____ cm.

4. Based on the information in #3, the height of 100 sheets of paper would be_____mm or_____cm.

5. Based on the information in #4, the height of 1,000,000 sheets of paper is _____ mm or _____ cm or _____ meters.

6. How would the height change if the paper were cardstock?
   _____
   _____.

7. Use the same procedure for cardstock as in #3 and #4. The height of 1,000,000 sheets of cardstock is _____ mm or_____cm or _____ meters.

8. If each story of a building is 3 meters high, how many stories would be in the building if its height were the same as that of a million sheets of cardstock? _____.
   Can you think of a building that is about that high?

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MEASURING A MILLION
Student Worksheet – Group #3

Problem:

If you take a million steps, starting from the door of the room, where will you be?

Process:

1. In which direction do you plan to travel? _____.

2. Where do you estimate you will be after taking a million steps in this direction?
   _____.
   The average estimate for my group is _____.

3. When I take 10 steps, the average distance traveled is _____.
   The average distance traveled for each member of my group is _____.

4. Knowing that 10 steps = _____feet, you can set up a proportion to find how many feet equal 1,000,000 steps.

$$\frac{10 \text{ steps}}{____ \text{ feet}} = \frac{1{,}000{,}000 \text{ steps}}{____ \text{ feet}}$$

   Cross multiply to solve for x. x = _____feet.

5. If 1 mile = 5,280 feet, how many miles equal a million steps? _____ miles.

6. Look at a map of your area. Where would you be after traveling a million steps north?
   _____.
   A million steps south?_____.
   East?_____.
   West?_____.

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Name: _____ Date: _____

MEASURING A MILLION
Student Worksheet – Group #4

Problem:

a) Imagine a crowd of one million people. How big a field do you think you would need to contain all of them?

b) If they were marching down the road, how long do you think the single-file row of marchers would be?

Process:

1. If an acre is about the size of a football field, you would probably need _____ acres to contain one million people. (estimate)

2. The average estimate for my group is _____ acres.

3. Have four students in your group stand together in a cluster. Mark the space around them with chalk on the floor and measure the space in square centimeters. Convert this to square meters. Ask four more to stand in that space. Does the area need to be enlarged?

4. Set up a ratio of people to area to find how many square meters are needed for a million people.

$$\frac{\text{4 people}}{\text{____ sq. meters}} = \frac{\text{1,000,000 people}}{\text{____ sq. meters}}$$

Cross multiply to solve for x.

5. If 1 acre = 4,047 square meters, about how many acres would you need to contain one million people? _____. Can you think of an area in your community that is about this size? _____.

6. Measure the length of four people standing one behind the other in a row. The length is _____ centimeters or _____ meters. The ratio of people to length is ___ : ___.

7. How many kilometers long would the line of people be?
(1 kilometer = 1,000 meters) _____km.
How many miles long is this?
(1 mile = 1.6 kilometers)_____ miles.

8. Look at a map of your state or country. Can you find a distance between two cities that is equal to the length of the row of a million people? _____.

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ACTIVITY 3

Seeing Double

Concepts:
Populations can grow exponentially, continuing to double.

Objectives:
Students will be able to:
▶ Solve two riddles about exponential growth.
▶ Observe and record data on the growth of a fruit fly population.
▶ Use inductive reasoning to draw conclusions about population growth trends.

Subjects:
Math, Science

Skills:
Problem solving, multiplying, counting, observing

Method:
Riddles and a laboratory activity using fruit flies reinforce students' understanding of exponential growth.

Introduction:

Populations often grow **exponentially**, doubling over and over until a very small amount becomes a very large amount. The following activities will help students better understand this growth pattern. The riddles illustrate the "power of two" and the fruit fly lab gives a hands-on demonstration of the exponential growth of an actual population of organisms.

Materials:

Provide enough of the following for each lab group:

Fruit flies*
Mashed banana
Baby food jars
Ether*
Cotton gauze
Piece of muslin
Paper towel
Graph paper

*order from a science lab supplier

Part 1: Doubling Riddles

Try these doubling riddles out on your students and encourage them to test them out on their families and friends.

1. You are a lily pad on a pond. Today you have only one fellow lily pad living on the pond with you. But your population is growing. Its doubling time is one day. So every day the population is twice as big as the day before. Tomorrow there will be four of you. It will take exactly 20 days for your pond to be completely full of lily pads.

   On what day will the pond be one-half full?

   Day 19

   Do you think you and your fellow lily pads will feel concerned on that day about running out of space? Why or why not?

   Perhaps not. With only half the space taken, the lily pads may feel that they still have plenty of room to expand.

   How will the pond filling up affect you and your fellow lily pads?

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2. A father complained that his son's allowance of $5 per week was too much. The son replied, "Okay, Dad. How about this? Let's change my weekly allowance for one month using this rule: You give me a penny on the first day of the month, two cents for the next, four cents for the next, eight cents for the next, and so on for every day of the month." The father readily agreed. Who was the more clever? What would be the son's allowance on day 31?

The son was the more clever. His allowance on day 31 alone is $10,737,418.24. This does not count how much he received on all the previous days. This is a good example of how doubling even a small amount over time can really add up.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 $.01	2 $.02	3 $.04	4 $.08	5 $.16	6 $.32	7 $.64
8 $1.28	9 $2.56	10 $5.12	11 $10.24	12 $20.48	13 $40.96	14 $81.92
15 $163.84	16 $327.68	17 $655.36	18 $1,310.72	19 $2,621.44	20 $5,242.88	21 $10,485.76
22 $20,971.52	23 $41,943.04	24 $83,886.08	25 $167,772.16	26 $335,544.32	27 $671,088.64	28 $1,342,177.28
29 $2,684,354.56	30 $5,368,709.12	31 $10,737,418.24	Hey Dad, about my allowance...			

Part 2: Fruit Fly Frenzy

Students will get to observe exponential growth of a living organism firsthand in this fruit fly lab. Because ether is used to anesthetize the fruit flies for counting, you may want to demonstrate this for students at the front of the class. For older students, you can divide them into groups and have each group conduct the lab with their own set of fruit flies.

Procedure:

1. Prepare a home for fruit flies by placing either some mashed banana or a thick mixture of cream of wheat and brown sugar in the bottom of a baby food jar. You may be able to attract fruit flies from your school surroundings into this jar or you can order them from a supplier. Start the jar with a small number of fruit flies. Cover your jar with a piece of muslin to allow air into the jar.

2. Have students copy the chart on page 21 into their notebooks. For day 1 they will record the number of fruit flies in the jar at the start of the lab. They will then make population counts every day for four weeks.

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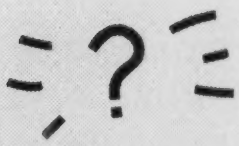
3. In order to count the flies, you will need to anesthetize them. Wet cotton gauze in ether and hold the gauze over the top of your fruit fly jar. Do this in a well-ventilated area. Watch the flies carefully. Do not expose them too long to the ether. As soon as their motion stops, remove the gauze and dump the flies onto a paper towel to count them. Return them quickly to the jar, as the flies will soon revive from their sleep.

4. Have students record the counts on their chart and make a graph of the population growth. What is the shape of the graph?



Discussion Questions:

1. Is it impossible for the fruit fly population to increase in size forever in the system you have set up? Why?

   Yes. There is a limited amount of food and space for the fruit fly population.

2. What do you think might happen to the fruit flies if the population continues to grow?

   Fruit flies will eventually begin to die if the population grows too large with limited amounts of food and space.

3. Could any population continue growing forever on Earth? Why or why not?

   No. Certain factors limit population growth, such as food shortages, disease, space, predators and climate. Human beings, while able to develop technologies and behaviors that stretch these limits, still rely on the basic necessities of life.

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Fruit Fly Population Counts			
Day	Number	Day	Number
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

Part 2 adapted with permission from Joni Keating as included in *Is There Room For Me? The Growth and Regulation of Populations*, Good Apple, Inc., ©1981.

Follow-up Activity:

Once students see how populations of fruit flies double, they can apply this information to human populations. It took the entire history of humankind for the population to reach 1 billion around 1810. Just 120 years later, this doubled to 2 billion people (1930); then to 4 billion in 1975 (45 years). By the year 2020, the population will likely be at 8 billion.

Put the following question on the chalkboard: "Can the Earth's population go on doubling forever?" List students' reasons for their answers on the board. You may want to prompt them by asking them to think about food supply, clean water, homes, forests, wildlife and competition for resources.

ACTIVITY 4

The Stork And The Grim Reaper

Concepts:
Populations growth occurs when a species' birth rate exceeds its death rate.

Objectives:
Students will be able to:
▶ Describe how birth and death rates affect population growth.
▶ Explain why death rates have dropped in recent history.

Subjects:
Social Studies, Science, Math

Skills:
Observing, critical thinking, calculating with fractions

Method:
In a short demonstration, students observe how populations grow when the birth rate exceeds the death rate.

Introduction:

Population growth occurs when a species' birth rate exceeds its death rate. Worldwide, the human birth rate is currently three times the death rate. Every environment has a limit to the number of members of a certain species it can support. Humanity's rapid population growth has the potential to exceed the carrying capacity of this planet. This activity is a visual demonstration of the relationships between birth rate and death rate and of population growth within a finite space.

Materials:

Clear container of 1 qt. capacity
An old towel
"Stork" and "Grim Reaper" name tags
Masking tape
Bucket of water
Food coloring
Set of measuring cups
Globe or map of the world

Procedure:

1. Fill the bucket with water and add food coloring so it will be more visible in the clear container. Place the empty, clear container with the towel under it in front of the class.

2. Ask for two volunteers from the class to assist. Designate one the "Stork" and the other the "Grim Reaper." Each student should tape the appropriate name tag to him/herself.

3. Hold up the clear container.

"This will represent the world, and the colored water in the bucket will represent people. Stork, you'll be adding people to the world by pouring dippers of water into the container. Grim Reaper, you'll be taking people from the world by scooping water out of the clear container and pouring it back into the bucket. At this time, the world's birth rate is three times the death rate. Based on that fact, who should receive the large dipper?" *(Stork)*. "Who should use the small dipper?" *(Grim Reaper)*.

Give the 1-cup dipper to the Stork and the 1/3-cup dipper to the Grim Reaper. Signal the Stork and Grim Reaper to start. Make sure that for every dipper-full the Stork adds, the Grim Reaper subtracts one. They should continue in turn while the class observes. When it becomes clear that the water level is steadily rising tell the Stork and Reaper to stop.

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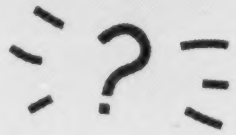
Discussion Questions:



1. Why did the water level rise steadily?

   Because more was being added than taken out.

2. What would this mean if the clear container really were the world?

   It would mean that the Earth's carrying capacity could be exceeded and that not all of these people could survive.

3. What size would the Grim Reaper's dipper have to be for the water level to stay the same?

   The same size as the Stork's dipper.

4. Throughout history, the Stork and Grim Reaper's real-life dippers were usually about the same size. But over the last 200 years, the Grim Reaper's dipper has become much smaller than the Stork's. Can you think of some reasons why the death rate has gone down in recent years?

   Advances in medicine: *Doctors gradually became better at healing people because of new discoveries in the sciences and from increased contact with other countries, which allowed them to learn from each other.* ***Better sanitation:*** *People invented safer ways of disposing of garbage and human waste so their surroundings were cleaner and didn't breed so much disease.* ***Better nutrition:*** *Advances in farming made it possible to grow better food in greater quantities. Also, improvements in medicine made people more aware of the importance of eating a variety of foods.*

   All of these things worked to allow more people to survive infancy and childhood and extended the average life span. People used to only live to be about 40 or maybe 50, whereas now many people survive much longer.

Follow-up Activity:

Provide students with the birth and death rates for the countries listed on page 24. Ask pairs of students to come forward, choose the appropriate measuring cups to represent those rates and demonstrate the growth rate by role-playing "Stork" and "Grim Reaper."

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Show the different growth rates of the countries below.

	Birth Rate	Death Rate	
United States:	15/1,000	9/1,000	1 cup: 1/2 cup
Mexico:	27/1,000	5/1,000	1 cup: 1/4 cup
Botswana:	38/1,000	11/1,000	1 cup: 1/3 cup
Italy:	9/1,000	10/1,000	1 cup: 1 cup
Japan:	10/1,000	7/1,000	1 cup: 2/3 cup
Taiwan:	15/1,000	5/1,000	1 cup: 1/3 cup

Ask students to find each country on the globe or map before beginning. Be sure both sets of people work at the same speed, with the different growth rates shown by variations in sizes of dippers. The more slowly growing countries, of course, will have a more slowly rising water level.

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3. Based on the rate of natural increase, students can now determine each country's population doubling time with the following formula. Keep in mind that these figures will reflect growth due to natural increase alone without considering emigration and immigration.

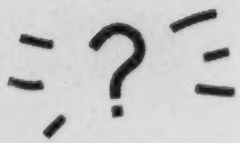
$$\text{Doubling Time (in years)} = \frac{70}{\text{Rate of Increase}}$$

(Note: 70 is considered the "magic number" for calculating doubling time. It is the approximate equivalent of 100 times the natural logarithm of 2.)

For example, to calculate the doubling time for the world population at the present rate of increase:

$$\frac{70}{1.5} = 47 \text{ years}$$

(Rounded answers in years: 117; 32; 233; 350; 70; 37; 21; 19; 30; will not double at current rate; losing population)



Discussion Questions:

1. Why do you think the population of some countries doubles much more rapidly than others? Why do you think some countries, such as Italy, reached zero population growth (z.p.g.)?

   The doubling time is shorter in countries where the rate of growth is higher. The greater the difference between the birth rate and the death rate, the faster the population growth. Many European countries, such as Italy, have reached zero population growth because their birth and death rates are about the same.

2. Which figures differ most greatly between countries, the birth rates or the death rates? How would you explain the wide disparity in birth rates among different countries?

   The birth rates vary more. The birth rate is higher when the average family size is larger. A country such as Kenya averages nearly six children per family, while the United States averages about two children per family.

3. If you were a national leader in Kenya or Iraq, would you be concerned about the rapid population growth? Why or why not? Similarly, if you were a national leader in Italy, would you be concerned that your country had reached z.p.g.? Why or why not?

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ACTIVITY 5

On The Double

Introduction:

The annual population increase throughout the world is currently 1.5%. While this number may sound small, today's population will double in just 47 years if we continue to grow at this rate. This growth is by no means uniform. At current rates, many countries will double their populations in less than 25 years, while others have reached zero population growth (z.p.g.) and do not expect to grow at all.

Materials:

Student Worksheet (one per student)
Calculator (optional)

Procedure:

1. Explain to students that the larger the difference between a nation's birth rate and its death rate, the greater the increase in population growth. Ask them to look at the chart on page 28 and determine which country will have the highest rate of increase. Which countries will lose population at their current rates?

   Answers: Iraq; Italy and Russia

2. Now have students determine the rate of annual increase for each country's population, using the following formula:

$$\% \text{ Annual Increase} = \frac{\text{Birth Rate - Death Rate}}{10}$$

   For example, the world's annual population increase in 1996 can be calculated by knowing that the birth rate is 24 births/1,000 people and the death rate is 9 deaths/1,000 people:

$$24 - 9 = 15 \text{ per } 1{,}000$$

$$\frac{15}{10} = 1.5\% \quad (1.5 \text{ per } 100)$$

   (Answers in percents: 0.6; 2.2; 0.3; 0.2; 1.0; 1.9; 3.3; 3.7; 2.3; -0.1; -0.6)

   (Note: Immigration and emigration also affect a county's annual population increase. For example, the annual population increase in the United States is actually 1.0% if immigration is included.)

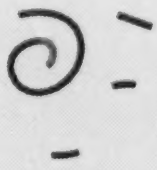
Concepts:
Even seemingly small growth rates can make a population double quickly.

Objectives:
Students will be able to:
▶ Explain the relationship of birth rates and death rates, and how they affect population change.
▶ Calculate the rate of natural increase for several countries, as well as their corresponding population doubling times.

Subjects:
Math, Science, Social Studies

Skills:
Calculating percentages, doubling times

Method:
Students use math formulas to calculate the growth rates and doubling times for the populations of different countries.



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Follow-up Activity:

Have students make a list of possible environmental, social and economic consequences of living in a country where the population increases as quickly as it does in Iraq, Kenya, Mexico or South Africa. Divide the class into groups and have each group research living conditions in a different developing country that is experiencing rapid population growth. Students could use the resources in their school or community library. Each group should then present their findings to the class.

Data source: "*World Population Data Sheet*," published annually by the Population Reference Bureau. To order an updated edition, contact: PRB, 1875 Connecticut Avenue, N.W., Suite 520, Washington, DC 20009; (202) 483-1100.

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ON THE DOUBLE
Student Worksheet

Use the formulas below to calculate the rate of natural increase and the doubling times for the populations of the countries listed on the chart below.

$$\% \text{ Annual Increase} = \frac{\text{Birth Rate - Death Rate}}{10}$$

$$\text{Doubling Time (in years)} = \frac{70}{\text{Rate of Increase}}$$

Country	Birth Rate in 1996 (per 1,000 people)	Death Rate in 1996 (per 1,000 people)	Annual Natural Increase (%)	Doubling Time (in years)
United States	15	9		
Mexico	27	5		
Japan	10	7		
United Kingdom	13	11		
China	17	7		
India	29	10		
Kenya	45	12		
Iraq	44	7		
South Africa	31	8		
Italy	9	10		
Russia	9	15		

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ACTIVITY 6

Power Of The Pyramids

Introduction:

To help them make population projections for different countries, demographers look at the profile of the countries' residents. What are the ages of the people? How many are men? How many are women? Taking this information, they construct "population pyramids" like the ones students will create in this activity. These graphs depict the configuration of a country's population as impacted by 70 to 80 years of economic, political and natural events. These graphs can also help predict future population trends.

Materials:

Student Worksheets (one per student)
Graph paper
Colored pencils
Ruler
Calculator (optional)

Procedure:

1. Display the sample world population pyramid on page 30 and explain that this is a kind of graph used by demographers to study the distribution of people across age categories.

2. Assign each student or group of students one of the six countries and distribute graph paper and a copy of the Student Worksheet for that country.

3. The figures on the worksheet represent the population (in thousands) of each age group within each gender for each particular country. In order to construct the country's pyramid, students must first calculate the percentage of the population of each gender in each age group.

   Example: According to the worksheet, the total population of the United States in 1995 was 263,119,000. The population of males aged 0-4 was 10,515,000 of the United States.

$$\frac{10{,}515{,}000}{263{,}119{,}000} = .04 \text{ or } 4\%$$

   Students should complete these calculations for each cohort (age group).

4. Using graph paper, students can construct a population pyramid as in the example. A line drawn down the middle of the graph separates the male and female populations. The percentages of the population will be plotted along the X-axis – females to the right, males to the left of the center line. The age groups will be running up the Y-axis with the youngest at the bottom, oldest at the top. (See "World Population Pyramid" sample.)

Concepts:
The age and gender distribution of a regional or national population affects its growth rate.

Objectives:
Students will be able to:
- ▶ Calculate percentages using raw numbers for each age/gender group in a given population.
- ▶ Construct a population age/gender distribution graph for one of six different countries.
- ▶ Make correlations between the shapes of the graphs and the countries' different growth patterns.

Subjects:
Math, Science, Social Studies

Skills:
Calculating percentages, graphing, analyzing and interpreting data

Method:
Students construct and interpret population pyramids and discuss differences in population growth rates among several different countries.

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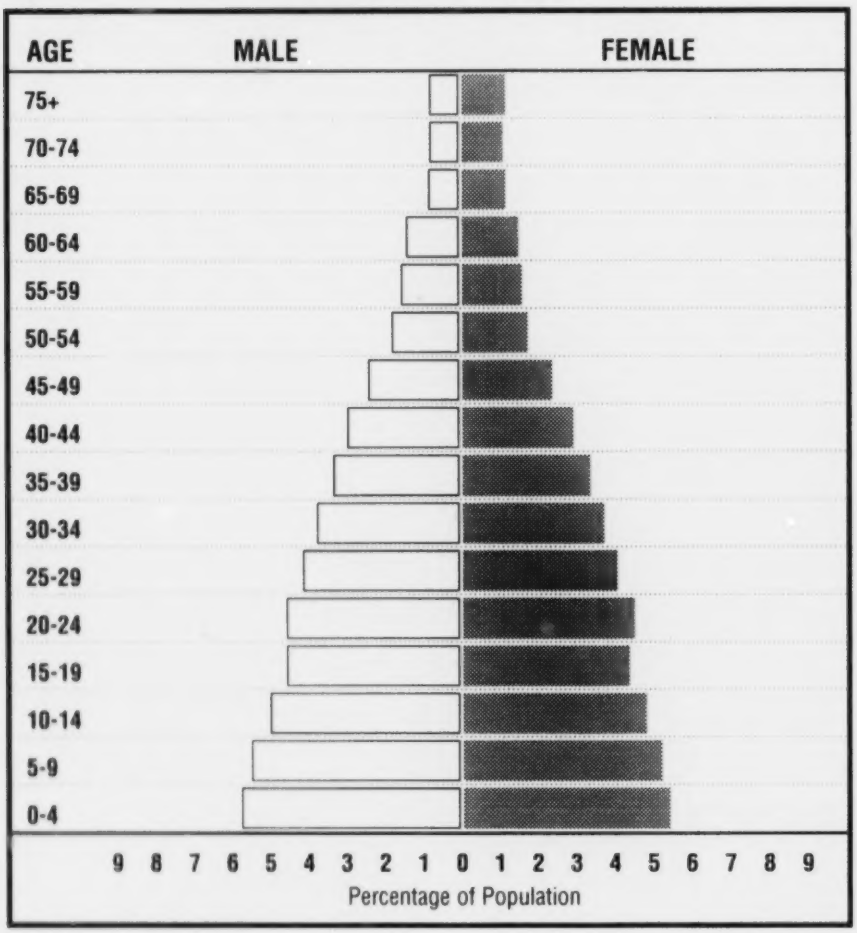
Note: Make sure the scale on the X-axis goes up to 9% in each direction to encompass everyone's data.

5. Have students graph the percentage data for their assigned country. Using colored pencils, they can shade in the two sides of their graphs.

6. Have students hold up their finished graphs for all to see while going through the discussion questions in class.

World Population Pyramid



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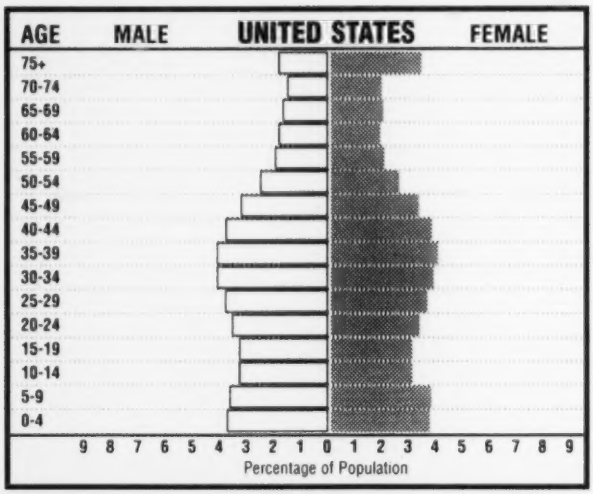
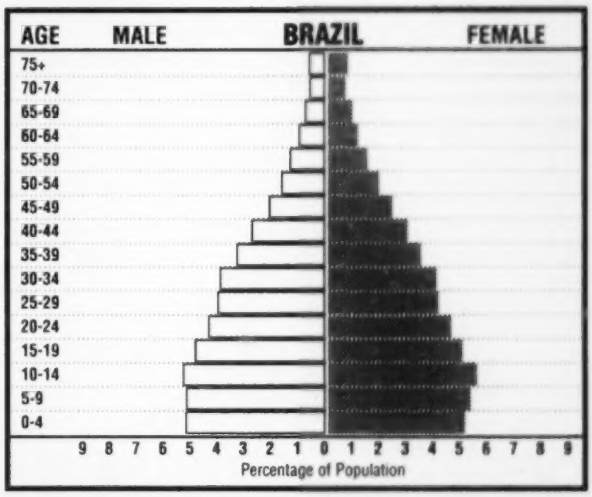
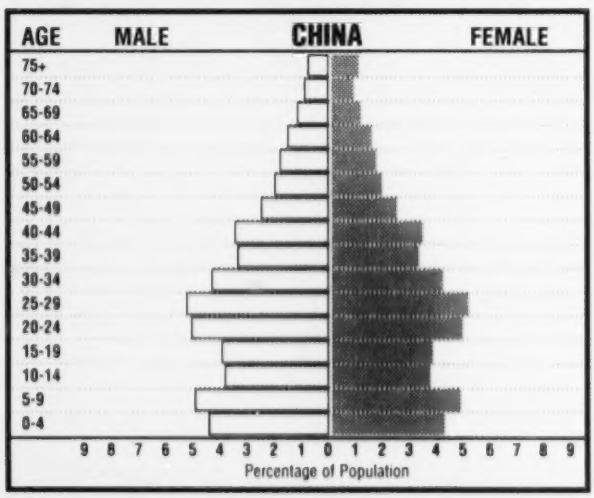
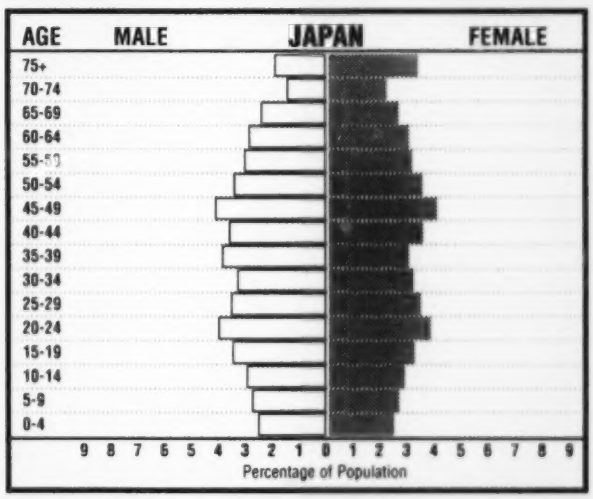
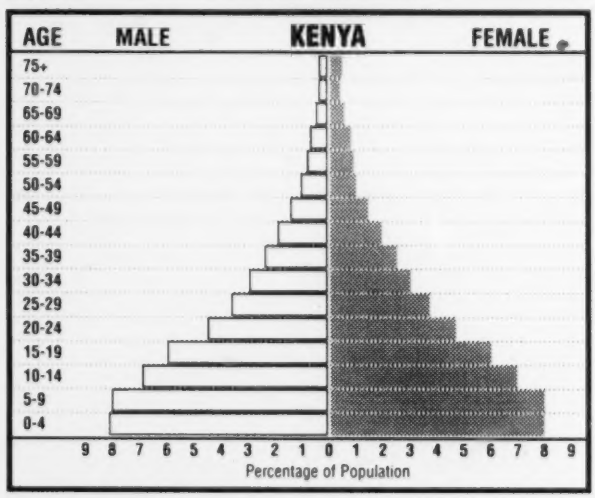
POWER OF THE PYRAMIDS
Sample Pyramids

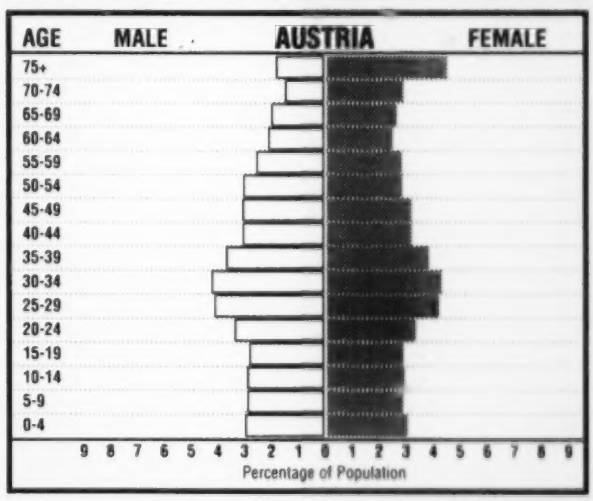












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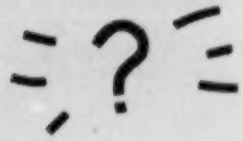

Discussion Questions:

1. Where are you represented on the Student Worksheet table and on the graphs?

   If you live in the United States and are between 10 and 15 years old you are represented on line 3 in the U.S. data under either male or female. On the graph, you and your cohorts make up the percentage presented by the third bar from the bottom, boys on the left, girls on the right.

2. Can you tell from the data if there are more boy babies or girl babies in each country?

   Yes, there are more boy babies. There is a slightly greater probability of giving birth to male children. For every 100 girls born, there are about 105 boys born.

3. Are there more elderly women or men? Why might that be the case?

   There are more elderly women. Throughout the world, life expectancy for women is higher than for men. This is due to a number of genetic and social factors. In general, men are more predisposed to certain health risks than women. Also, men make up the vast majority of the military, and are more likely to die during wars.

4. Can you tell from the graphs which country has the most people?

   No. The graphs represent 100% of the population of each country broken down by age groups. Demographers use the percentage data instead of the raw data so that each graph fits on the same size paper and can be compared to the graphs of other countries.

5. Which country has the most people? How can you tell?

   From the Total line on Student Worksheet #1 (page 34), you can tell that China has more people than any other country.

6. Of the six graphs, which two look most like pyramids? What does that indicate about their population growth rates? What factors would change the shape of the pyramids in the future?

   The graphs for Kenya and Brazil look most like pyramids. This indicates a high growth rate. Population growth occurs when the segment of the population currently in its childbearing years (ages 15-44; bars 4-10 on the graphs on page 31) has produced a generation larger than itself (bars 1-3). If the birth rate goes down, this would change the shape of the graph over time from a pyramid to more of a rectangle, indicating a more stable population.

7. Looking at the pyramids, which countries appear to have the slowest rates of population growth? How can you tell?

   Austria and Japan. The graphs are closer to rectangles than pyramids, showing more uniform population size across the age groups.

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8. Which are the biggest age groups in the United States?

People aged 30-50 make up the biggest portion of the United States, with babies a close second. The people who were born between 1946 and 1964 are called "baby boomers," and were born shortly after World War II, when many husbands and wives were reunited, and the country experienced greater economic prosperity than it did during the years of the Great Depression and the war. Couples felt confident of their ability to support families, and the birth rate soared as a result.

9. In which country do children make up the biggest percentage of the population?

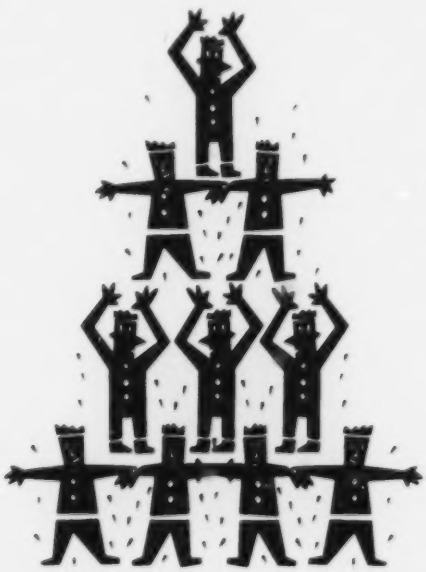
You can see on the graph that the bottom of the Kenyan and the Brazilian pyramids go out the farthest, representing the largest percentage. The percentages that you calculated show that Kenyan babies (males and females combined) make up about 16% (8 + 8) of the population and the older children also make up a big percentage.

10. If you had a business and wanted to capitalize on your information about the population age distribution for the United States, what would you sell?

Answers might include any products for people of the baby boom generation or their children.

11. If you had a business in Kenya and wanted to capitalize on your information about the Kenyan population, what would you sell?

Answers might include any products for children and infants.



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Power Of The Pyramids – Student Worksheet #1

Name: _____ Date: _____

Population in Thousands (1995)												
	United States				Brazil				China			
Age Group	M	%	F	%	M	%	F	%	M	%	F	%
0-4	10,015		10,009		8,643		8,256		55,642		51,073	
5-9	9,610		9,147		8,787		8,625		59,714		57,549	
10-14	9,445		8,982		8,874		8,800		47,233		43,974	
15-19	8,939		8,500		8,114		8,095		49,232		46,016	
20-24	9,366		8,906		7,354		7,387		62,779		58,952	
25-29	10,006		9,639		6,839		6,857		65,023		60,822	
30-34	10,990		10,848		6,652		6,690		54,417		50,205	
35-39	11,096		11,140		5,638		5,716		43,295		39,874	
40-44	10,031		10,137		4,723		4,826		44,159		41,285	
45-49	8,717		8,934		3,754		3,847		32,604		29,614	
50-54	6,739		7,026		2,911		3,005		25,235		22,416	
55-59	5,361		5,761		2,437		2,560		22,969		20,490	
60-64	4,771		5,369		1,923		2,070		20,212		18,662	
65-69	4,509		5,439		1,529		1,694		15,533		14,943	
70-74	3,876		5,173		1,060		1,224		10,807		11,324	
75+	5,043		9,097		1,083		1,373		10,272		13,007	
Total	129,012		134,107		80,319		81,055		619,126		580,206	
Total	263,119				161,374				1,199,332			

Source: The World Bank, *World Population Projections 1994-95 Edition.* (Baltimore: The Johns Hopkins University Press, 1994).

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Power Of The Pyramids – Student Worksheet #2

Name: _____ Date: _____

Population in Thousands (1995)												
	Japan				Kenya				Austria			
Age Group	M	%	F	%	M	%	F	%	M	%	F	%
0-4	3,224		3,074		2,249		2,214		249		236	
5-9	3,491		3,330		2,232		2,219		237		224	
10-14	3,809		3,622		1,928		1,919		242		232	
15-19	4,359		4,141		1,655		1,656		233		221	
20-24	5,116		4,868		1,290		1,296		279		267	
25-29	4,558		4,351		1,016		1,024		346		332	
30-34	4,123		4,006		820		828		354		346	
35-39	4,904		3,843		654		665		306		305	
40-44	4,494		4,450		517		531		259		258	
45-49	5,286		5,264		380		396		254		252	
50-54	4,401		4,490		265		282		253		227	
55-59	3,877		4,024		233		255		215		222	
60-64	3,608		3,839		205		225		178		195	
65-69	2,985		3,365		152		169		166		209	
70-74	1,920		2,722		105		117		127		226	
75+	2,433		4,236		112		146		151		352	
Total	61,587		62,626		13,811		13,940		3,849		4,133	
Total	125,213				27,751				7,981			

Source: The World Bank, *World Population Projections 1994-95 Edition.* (Baltimore: The Johns Hopkins University Press, 1994).

Power Of The Pyramids – Answers to Student Worksheet #1

Population in Thousands (1995)												
	United States				Brazil				China			
Age Group	M	%	F	%	M	%	F	%	M	%	F	%
0-4	10,015	3.8	10,009	3.8	8,643	5.4	8,256	5.1	55,642	4.6	51,073	4.3
5-9	9,610	3.7	9,147	3.5	8,787	5.4	8,625	5.3	59,714	5.0	57,549	4.8
10-14	9,445	3.6	8,982	3.4	8,874	5.5	8,800	5.5	47,233	4.0	43,974	3.7
15-19	8,939	3.4	8,500	3.2	8,114	5.0	8,095	5.0	49,232	4.1	46,016	3.8
20-24	9,366	3.6	8,906	3.4	7,354	4.6	7,387	4.6	62,779	5.2	58,952	4.9
25-29	10,006	3.8	9,639	3.7	6,839	4.2	6,857	4.2	65,023	5.4	60,822	5.1
30-34	10,990	4.2	10,848	4.1	6,652	4.1	6,690	4.1	54,417	4.5	50,205	4.2
35-39	11,096	4.2	11,140	4.2	5,638	3.5	5,716	3.5	43,295	3.6	39,874	3.3
40-44	10,031	3.8	10,137	3.9	4,723	2.9	4,826	3.0	44,159	3.7	41,285	3.4
45-49	8,717	3.3	8,934	3.4	3,754	2.3	3,847	2.4	32,604	2.7	29,614	2.5
50-54	6,739	2.6	7,026	2.7	2,911	1.8	3,005	1.9	25,235	2.1	22,416	1.9
55-59	5,361	2.0	5,761	2.2	2,437	1.5	2,560	1.6	22,969	1.9	20,490	1.7
60-64	4,771	1.8	5,369	2.0	1,923	1.2	2,070	1.3	20,212	1.7	18,662	1.6
65-69	4,509	1.7	5,439	2.1	1,529	0.9	1,694	1.1	15,533	1.3	14,943	1.2
70-74	3,876	1.5	5,173	2.0	1,060	0.7	1,224	0.8	10,807	1.0	11,324	0.9
75+	5,043	1.9	9,097	3.5	1,083	0.7	1,373	0.9	10,272	0.9	13,007	1.1
Total	129,012	49	134,107	51	80,319	50	81,055	50	619,126	52	580,206	48
Total	263,119				161,374				1,199,332			

Source: The World Bank, *World Population Projections 1994-95 Edition.* (Baltimore: The Johns Hopkins University Press, 1994).

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Power Of The Pyramids – Answers to Student Worksheet #2

Population in Thousands (1995)												
	Japan				Kenya				Austria			
Age Group	M	%	F	%	M	%	F	%	M	%	F	%
0-4	3,224	2.6	3,074	2.5	2,249	8.1	2,214	8.0	249	3.1	236	3.0
5-9	3,491	2.8	3,330	2.7	2,232	8.0	2,219	8.0	237	3.0	224	2.8
10-14	3,809	3.0	3,622	2.9	1,928	6.9	1,919	6.9	242	3.0	232	2.9
15-19	4,359	3.5	4,141	3.3	1,655	6.0	1,656	6.0	233	2.9	221	2.8
20-24	5,116	4.1	4,868	3.9	1,290	4.6	1,296	4.7	279	3.5	267	3.3
25-29	4,558	3.6	4,351	3.5	1,016	3.7	1,024	3.7	346	4.3	332	4.2
30-34	4,123	3.3	4,006	3.2	820	3.0	828	3.0	354	4.4	346	4.3
35-39	4,904	3.9	3,843	3.1	654	2.4	665	2.4	306	3.8	305	3.8
40-44	4,494	3.6	4,450	3.6	517	1.9	531	1.9	259	3.2	258	3.2
45-49	5,286	4.2	5,264	4.2	380	1.4	396	1.4	254	3.2	252	3.2
50-54	4,401	3.5	4,490	3.6	265	1.0	282	1.0	253	3.2	227	2.8
55-59	3,877	3.1	4,024	3.2	233	0.8	255	0.9	215	2.7	222	2.8
60-64	3,608	2.9	3,839	3.1	205	0.7	225	0.8	178	2.2	195	2.4
65-69	2,985	2.4	3,365	2.7	152	0.5	169	0.6	166	2.1	209	2.6
70-74	1,920	1.5	2,722	2.2	105	0.4	117	0.4	127	1.6	226	2.8
75+	2,433	1.9	4,236	3.4	112	0.4	146	0.5	151	1.9	352	4.4
Total	61,587	49*	62,626	50*	13,811	50	13,940	50	3,849	48	4,133	52
Total	125,213				27,751				7,981			

Source: The World Bank, *World Population Projections 1994-95 Edition.* (Baltimore: The Johns Hopkins University Press, 1994).
*Due to rounding, Japan's male and female percentages do not add up to 100%

ACTIVITY 7

Stage Stepping

Concepts:
Average family size determines how a population grows.

Objectives:
Students will be able to:
▶ Construct bar graphs showing population age distribution for two- and three-child average families over five generations.

Subjects:
Math, Social Studies, Family Life Education

Skills:
Simulating models, looking for patterns, constructing a bar graph, critiquing models

Method:
Students simulate several generations of a family's growth, comparing a two-child and three-child average family size.

Introduction:

Small differences can add up quickly where population growth is concerned. A population with a higher average family size produces larger numbers of people over time than a population with a smaller average family size. This activity shows what a difference a two- versus three-child average family size can make over time.

Materials:

A set of wide steps, bleachers or 18 chairs
Minute timer
Bags of candy
4 signs: "Age 0-19"; "Age 20-39"; "Age 40-59"; "Age 60-100"
Large sheets of paper
Sticky dots

Procedure:

1. Tell the students that this activity is designed to show the importance of average family size. Explain that a large average family size can result in a significant increase in population over time. Point out that many different family sizes can result in an average size of two children per family. For example, one couple may have three children, one couple four children, one couple one child and one couple none, but the average of these four families is two children.

2. Using wide steps or bleachers in a gym or outdoors, label the bottom step "Age 0-19," the second step "Age 20-39," the third step "Age 40-59," and the fourth step "Age 60-100." If no bleachers or steps are available, you can substitute rows of chairs or just place the signs along one wall. In the classroom, you can use two rows of chairs. When doing the activity, designate people sitting on the floor in front of the first row of chairs to be " Age 0-19", people sitting on the front row of chairs to be "Age 20-39", people standing behind them to be "Age 40-59", and people standing on the back row of chairs to be "Age 60-100."

3. Ask four students to represent the first generation, "Age 0-19," and to stand on Step 1. They will represent two couples. Explain that in this simulation, one minute will represent 20 years and each student will start his/her life when two others decide that he/she should be "born." After the first minute, have the two couples move up to Step 2 "Age 20-39" and select two students each to represent their children. They will stand on Step 1. The children from one couple will eventually pair up with the children from the other couple.

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4. After the next minute passes, the original couples will move up to Step 3 "Age 40-59" and have their "children" each select spouses from the other students on their step. (So, the children from couple #1 might select spouses from the children of couple #2.) Each of those couples must now select two students to stand on Step 1 to represent their children.

5. Continue the simulation as follows. After each 20-year (one-minute) interval, everyone should move up one step:

   a. Those aged 20-39 on Step 2 should select spouses, link arms and together choose two new children.

   b. Those aged 40-59 on Step 3 receive a bag of candy, contribute some to the other people in their family to pay for their education and medical care and put the rest on Step 4 for their retirement.

   c. Those aged 60-100 on Step 4 can eat any candy they put away for retirement, then "die" and return to their seats.

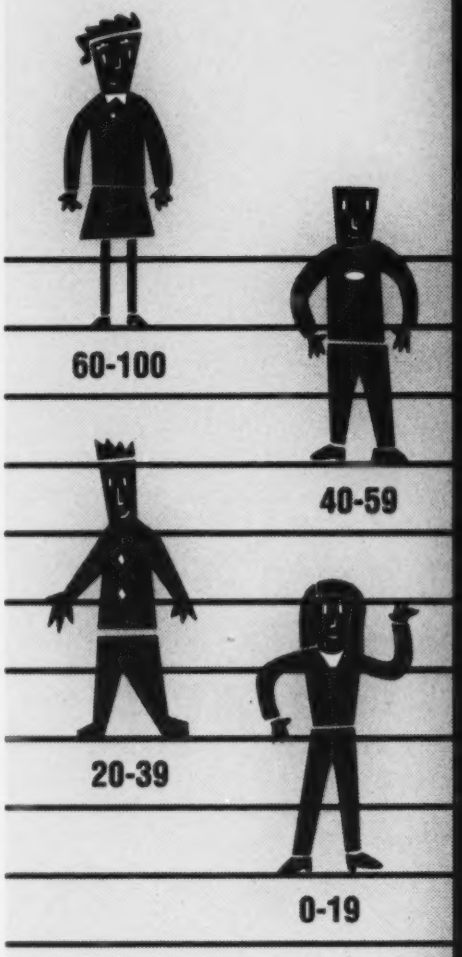
   d. Those selected to be born should stand in front of their parents on Step 1.

6. After the simulation has gone on for five generations, count the number of people on each step, and make a horizontal bar graph using sticky dots. Count the number of people who have died. What is the total number of people who either were on the steps at the end or passed through them during the activity? What is the largest number that were ever on the steps?

7. Begin the simulation again, but this time have each couple choose three children to be born. When an odd number occurs on a step with the three-child average, one person will proceed through the activity without pairing up with a spouse.

   Note: If you have fewer than 45 students, have them place pieces of paper or books on Step 1 to represent their children. Or, you can go through four generations only, requiring 31 students. Refer to the charts on page 41.

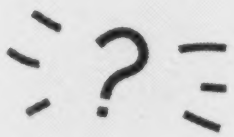
8. After five generations, tally the number of people on each step, make a bar graph and count the number of people who "died." How do these figures compare to the first simulation?



Discussion Questions:

1. Do you think there are a lot of situations where families follow either of these models? Why not?

   No. The sizes of generations in most families vary over time. People's family-size decisions depend on many things: marital status, economics, desire for more or fewer children, ability to have children and career choices, to name a few.



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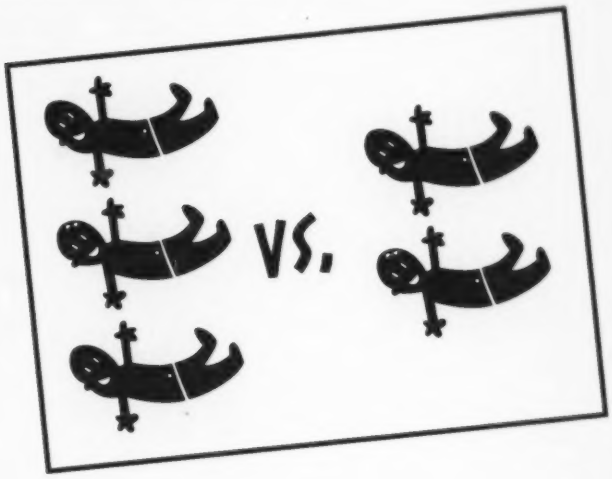
2. What difference would it make if millions of couples decided to have three children instead of two?

The population would grow quickly if the average number of children per family was 3 instead of 2.

3. How would the simulation change if the youngest generation began bearing children before age 20?

The younger people bear children, the likelier it is that there will be more generations of a family alive at one time, especially if this trend continues. Studies show that the younger people are when they bear their first child, the more children they are likely to have during their lifetimes.



Follow-up Activity:

Now that students understand the different growth patterns between two- and three-child average families over time, follow this activity with *Family Perspective*. This activity illustrates the true family sizes over several generations of the students' own families and allows for discussion on how family size decisions are sometimes made.

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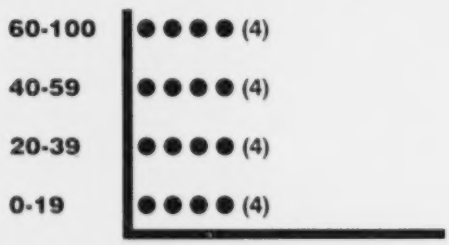
Two-Child Family – Number of Students on Each Step

	Step 1	Step 2	Step 3	Step 4
Beginning of simulation	4	0	0	0
After 1 minute	4	4	0	0
After 2 minutes	4	4	4	0
After 3 minutes	4	4	4	4
After 4 minutes	4	4	4	4

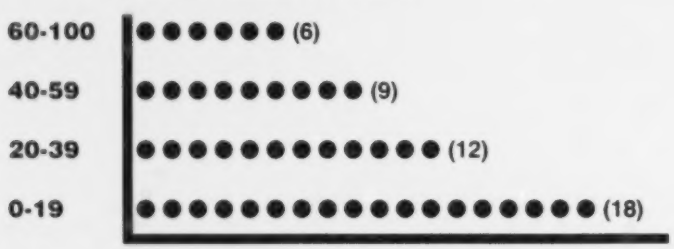
Three-Child Family – Number of Students on Each Step

	Step 1	Step 2	Step 3	Step 4
Beginning of simulation	4	0	0	0
After 1 minute	6	4	0	0
After 2 minutes	9	6	4	0
After 3 minutes	12	9	6	4
After 4 minutes	18	12	9	6

Models of Families for Stage Stepping
Two-Child Model



Models of Families for Stage Stepping
Three-Child Model



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ACTIVITY 8

Family Perspective

Concepts:
Each individual's decisions about childbearing contributes to population trends. Personal family-size decisions are influenced by the values of the larger society, and one's personal family-size decisions, in turn, have an impact on the larger society.

Objectives:
Students will be able to:
- ▶ Calculate family-size trends in their own families and the "society" composed of class members and their families.
- ▶ Identify at least two cultural values that may influence an individual's family-size decisions.
- ▶ Discuss impacts their own family-size decisions may have on the larger society.

Subjects:
Math, Family Life Education, Social Studies, Science

Skills:
Calculating averages and probability, rounding numbers, gathering data, graphing, critical thinking, identifying trends

Method:
Students complete a math activity on family-size trends and a simulation on family-size decision-making.

Introduction:

These two activities encourage students to consider the relationship between individual family-size decisions and population trends in the larger society. It is very important to be nonjudgmental as these matters are discussed in class and to encourage students to be tolerant of other family lifestyles. The point is not to focus the class' attention on individual students' families or on any particular family size as optimal, but to trace family-size trends generally and examine how individual decisions collectively influence larger population trends. Emphasize that the class is gathering data to determine the average. Some families will always be bigger and some smaller than the average, and this is to be expected.

Materials:

Part 1:

Student Worksheets (one per student)
Calculators (optional)
3 pieces of different colored paper per student (small squares)

Part 2:

Coin
Chalkboard and chalk or paper and pencil
Calculator (optional)
Butcher paper
Marker
Sticky dots
Ruler, yardstick or other straight edge

Part 1: Surveying Family-size Trends

Procedure:

1. Have students complete items 1-4 on the Student Worksheet. Students may substitute a guardian or other adult relative for mother or father in answering these questions if they prefer; some students may not have knowledge of a parent.

2. Distribute one piece of each of three colored papers to each student. Have students put their answers to item #1c on one color paper and pass the papers to a student who has been designated to tally the answers. Have them do the same for their answers to item #2 and item #3.

3. Each tallier will then determine the class average for each generation.

4. Graph these results on the chalkboard or on a bulletin board display.

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5. Ask students to describe any family-size trends they observe in the larger "society" formed by themselves and their relatives. Now have them respond to item #5 on their worksheets.

Part 2: It's a Toss-up

Procedure:

Many students want to have a boy and a girl when they have children, but what happens if they don't get a boy and a girl right away? This exercise simulates the kinds of situations people face in planning their families.

1. Take out a coin and announce that heads means a girl and tails means a boy. Ask one student to flip the coin to determine the sex of his/her first child. After seeing whether the child is a boy or a girl, the student must decide whether to flip again (have another child) or stop. Continue this process until the student's "family" is complete. Then record the total number of children the student "had" on a frequency table or bar graph as described below, and invite the next student to flip the coin.

2. A fun and effective way of recording the frequency of students' completed "family sizes" is to have them build a bar graph using sticky dots and butcher paper. On the paper, draw a horizontal line to serve as the bottom of the graph and a vertical line to serve as the left side of the graph. On the horizontal axis, labeled "Number of Children," mark off numbers from 0 to about 8 at regular intervals, leaving extra room at the right in case higher numbers are given. Label the vertical axis "Number of Responses." As students finish their turns, have them each place a sticky dot over the number of children they "had" so that they build vertical columns of dots.

3. When everyone has had a turn, ask students to calculate the average number of children the class "had." Compare this figure with the average number of children students originally said they wanted to have, assuming they could provide for them (item #3 on the Student Worksheet). Chances are the average number of "actual" children will be higher than the original average number of "desired" children.

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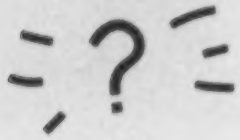

Discussion Questions:

1. Did most students "have" the number of children they originally said they wanted? Why?

2. What factors, besides income, determine how many children people have?

   Possible answers might include cultural and religious traditions and values, family traditions, career choices, lifestyle and use of family planning.

3. Why might a boy child or a girl child be preferred? How might this preference vary from one culture to another?

   Parents may feel that they could better "relate" to a boy or a girl based on their own experiences. There are also stereotypes that might determine preference, such as that "girls are better behaved than boys." In many developing countries, parents depend on sons to help support them in their old age, while girls are often married off to live with their husbands' families.

4. What difference does it make to a society's population whether there is a tradition of large families or a tradition of small families?

   In a society where most people have many children, the population grows quickly and the society must provide more goods and services for more people.

5. How do your personal family-size decisions affect other people in the society? How do they affect the natural environment?

   One person's decisions may not seem very significant in a large society. However, each person's decisions multiplied by everyone in the society add up to a lot. This is the same principle as voting in a national election. Think about what would happen if everyone makes the same choices as you do.

Part 2 was adapted with permission from Carolynn S. Howell, Palm Bay High School, Melbourne, FL.

Follow-up Activity:

From *It's a Toss Up*, students can see that desire for children of different genders sometimes determines family-size decisions. Another key determinant is family economics. For instance, during the Great Depression of the 1930s, American families were relatively small because couples could not afford to feed and take care of many children. During the years after World War II, the country experienced economic prosperity, contributing to the prolonged U.S. baby boom (1946-1964) where couples had more children. Discuss with students the different costs associated with having children (including education, health care, food, housing, clothing, transportation, recreation, etc.) and why it is important for prospective parents to be sure they can

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provide for their children. You may wish to have students research how much it can cost to support an average family of four in the United States. They can accumulate their data by saving weekly grocery receipts and checking the newspaper for average home prices and rentals in the area, car prices and so on.

Groceries: $57.21/week

Rent: $600/month

Car Payment: $240/month

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Name: _____ Date: _____

FAMILY PERSPECTIVE
Surveying Family-Size Trends
Student Worksheet

1. Generation One

You may substitute a guardian or other adult relative for mother or father as you answer these questions if you wish.

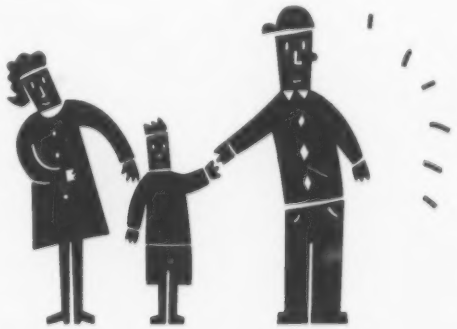
a) My mother's parents had ___ children, including my mother.

b) My father's parents had ___ children, including my father.

c) The average number of children in my two parents' families (Generation 1) is ___. (Don't worry if the number includes a fraction or decimal place.)

2. Generation Two

My parents have ___ children, including me.



3. Generation Three

I would like to have ___ children when I grow up, assuming I can provide for them.

4. Is there a family-size trend in your family? (Is the number of children getting larger, getting smaller, holding steady?) Describe what you see.

5. How does the family-size trend in your family compare with the trend in the larger "society" composed of your classmates' families?

Extra Credit Project: Gather this kind of data for 50 different persons. Prepare a presentation about family-size trends in this sample population, either on poster board or as a report.

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ACTIVITY 9

Cougar Hunt

Introduction:

It's been said that every person on the planet, around six billion of us, could fit into the state of Texas. But being able to fit a certain number of people into a space doesn't mean they'd be able to live there for any length of time. We need more than just a certain amount of space to survive; we need things like food and water. There isn't enough farmland or drinking water in Texas or in all of North America, for that matter, to support six billion people. Texas, the United States and the planet all have limits to how much they can give to support people. Every habitat does. This simulation helps students understand the concept of carrying capacity by having them act out the survival attempts of cougars living in an area with limited food resources.

Materials:

200 small paper cups to represent animals (prey). They are marked on the bottom as follows:

100 cups marked S (squirrel = 1 kg)
50 cups marked R (rabbit = 2 kg)
30 cups marked P (porcupine = 7.5 kg)
19 cups marked B (beaver = 20 kg)
1 cup marked D (deer = 75 kg)

Blindfold (could use a scarf or bandana)

Procedure:

1. Select a certain surface on which to spread the paper cups. This could be a counter or large table or the floor in one corner of a room or outdoors in the school yard. Set the cups out upside down so the students can see the letters marked. Using the list above, write the names of the five types of prey and the number of kilograms of food provided by each on the chalkboard.

2. Indicate the area where you have set out the cups. "This is the habitat of a population of cougars, or mountain lions. Each of you represents one cougar. Right now you will each try to find enough food in this habitat to survive for about a month, which is about 50 kg."

3. Select one student from the class and explain, "This cougar has been injured by tackling a big buck and now has a broken leg so that he/she will have to hunt on one leg." Tell the student to hop.

4. Select another student. "This cougar is blind due to an injury caused by a porcupine." (Give the student a scarf or bandana to use as a blindfold.)

Concepts:

Every piece of land has a limited carrying capacity for the number of animals and/or humans it can support.

Objectives:

Students will be able to:

- Act out their roles as cougars trying to amass food for survival.
- Calculate the amount of "prey" they gathered in kilograms.
- Define carrying capacity and explain how it relates to animals.
- Determine the similarities and differences between animal and human population growth patterns.

Subjects:

Science, Math, Social Studies

Skills:

Observing, understanding cause and effect, adding, role playing, using metric system

Method:

Students will gain a better understanding of what is meant by carrying capacity when they act as predatory animals in a finite area and attempt to accumulate enough food to stay alive.

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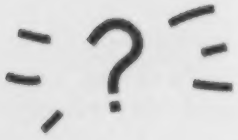
5. Select a third student. "This cougar is a female with two cubs and each cub needs 25 kg of food to live, so if they are all going to survive, she needs to find 100 kg of food."

6. Indicate the list on the board and read it aloud to be sure the students understand what they're looking for. Ask each student to set up a cougar den by selecting a small area where he/she will bring his/her prey. This could be a student's desk or areas along the wall.

7. Give students the following instructions: "Each cougar must walk into the habitat to hunt. (Cougars don't run down prey, they stalk it.) When a cougar finds a prey animal, he or she picks it up and carries it to his or her den. Each cougar can only carry one prey animal at a time. Remember that in the wild, cougars don't fight over prey, as a resulting injury may kill them." The students continue to repeat the process until the game is over, picking up just one prey species per trip.

8. When all the paper cups have been gathered, the game is over, and each student returns to his/her desk to calculate the quantity of food he/she gathered.

9. Ask students to announce to the class the amount of food they gathered. On the chalkboard, record these numbers vertically in descending order. Then, draw a horizontal line at "50" to represent the amount needed to survive. Any cougars who gathered 50 kg or more would survive, while the others would not. Note: You may need to adjust the amount of prey needed to survive based on the number of students in your class. With the amount of prey available using 200 paper cups, about 10-18 cougars would survive. This would be an appropriate portion for a class of 25-30 students.



Discussion Questions:

1. How many kilograms did each cougar gather? How many cougars can survive in the habitat? If more cougars played the game, would the habitat support them? Why?

   Having more predators than prey would mean fewer prey animals would survive to reproduce. Because more would be taken out than was being put back, the food supply wouldn't be sufficient to support the cougars.

2. How many kilograms did the blind cougar gather? The injured cougar? The mother cougar? What are the chances of her cubs surviving in this habitat? Can a blind or injured cougar survive in the wild? Who is the mother going to feed first?

   She will probably feed herself first to keep healthy so that she can tend to her cubs. If she doesn't survive, they have no chance at all. Even if this litter doesn't survive, perhaps the habitat will support healthy cubs in the future.

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3. Who got the deer? The deer was worth 75 kg of meat, which is half again as much food as any cougar needed for survival. Would a real cougar have continued to hunt after getting that much food? Why or why not?

No. Animals in the wild only hunt and eat when they're hungry — they only take as much food as they need.

4. What would happen to the cougar population if all the rabbits died of a disease?

This would cut the cougars' food supply significantly. They would have to eat more of the other animals than usual to make up for the lack of rabbits, which would reduce the populations of the other prey animals.

5. Conversely, what would happen to the cougars' prey animals if the cougars' numbers dwindled as a result of humans hunting them intensively?

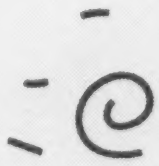
Just as the cougars compete with each other for the prey animals, the prey animals compete with each other for their food — the plants within the habitat. If the cougars are not around to keep the herbivores' numbers in check, the area will not be able to provide enough vegetation to support the extra animals.

6. What would happen to the cougar population if the water became polluted?

The cougars and all the other animals drinking that water would become sick and some of them might die. If different proportions of predator and prey animals died, it could upset the balance of the food chain.

Why would the concentration of the pollutant be greatest in the cougars?

All creatures store the pollutants they've consumed over their lifetimes in their bodies — they never go away. Because the cougars are at the top of the food chain, they are not only getting their share of the pollutant from the drinking water, but they are taking in all of the pollutants stored in the tissues of each animal they eat.



7. Though this game is about the carrying capacity of cougars in a region, do the same rules apply to humans? How are they similar?

Yes. One similarity is that humans are at the top of the food chain. Another is that, just as the cougars competed for prey in their hunting area, humans compete for a limited number of resources within our habitat (society).

How are they dissimilar?

An example of a dissimilarity is that humans generally don't stop "hunting" when we have enough; we continue competing for more than we need.

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What do humans compete over?

As individuals, we compete mostly for money and the things it can buy. We also compete over means of becoming more fit to compete for money, through things like education and jobs. As nations, we compete for resources like land, water, gasoline, oil, timber, minerals, etc.

Follow-up Activity:

Once students have grasped the concept that the size of an animal population depends on the amount of available resources, extend the idea of carrying capacity to humans through one or both of the following two activities: "*World Real Estate*" and "*Growing Pains in Texas Hill Country.*"

Cougar Hunt was adapted with permission from Joan Wagner, Burnt Hills Middle School, Burnt Hills, NY. It is based on "Oh Deer!", an activity developed by Project WILD, ©1983.

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ACTIVITY 10

World Real Estate

Introduction:

Every environment has a **carrying capacity** — the point at which it can no longer support additional members of a species with the natural resources they need to survive. When asked to determine how much land a human being needs for survival, students may think only in terms of their living space. They often do not realize how much land is needed to provide them with food, fuel, shelter and textiles for clothing.

Part 1 below is a demonstration that makes an excellent opener for a lesson on carrying capacity. Part 2 presents students with a number of problem-solving challenges related to world land use.

Materials:

Part 1:

Large apple
Kitchen knife

Part 2:

Student Worksheets (one per student)
Calculator (optional)

Part 1: Earth: The Apple of Our Eye

Procedure:

1. Tell students to think of the Earth as an apple. Slice an apple into quarters and set aside three of the quarters. Ask, "What do these represent?" *The oceans of the world.* The fourth quarter roughly represents the total land area of the world.

2. Slice this "land" in half. Set aside one of the pieces. The portion set aside represents the land area that is inhospitable to people: the polar areas, deserts, swamps, very high or rocky mountains. Ask, "What fraction do we have left?" (1/8). The piece that is left is land where people live but do not necessarily grow the foods needed for life.

3. Slice the 1/8 piece into four sections and set aside three of these. Ask, "What fraction do we have left?" (1/32). The 3/32 set aside represent the areas too rocky, too wet, too cold, too steep or with soil too poor to actually produce food. They also contain the cities, suburban sprawl, highways, shopping centers, schools, parks, factories, parking lots and other places where people live but do not necessarily grow food.

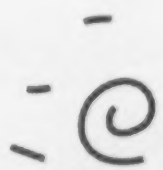
Concepts:
The size of any population, including the human population, must have an upper limit, as there is only a finite amount of essential resources to support the population.

Objectives:
Students will be able to:
- Define carrying capacity.
- Calculate land availability per person.
- Identify what portion of the Earth is arable land.

Subjects:
Science, Math, Social Studies

Skills:
Estimating, calculating percentages, dividing, graphing, critical thinking

Method:
Students observe a demonstration of world land use and determine approximately how much of the Earth's surface is land used to grow food crops. They then calculate how much land there is for each person on Earth, given different population sizes, and what types of habitat make up the land.



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4. Carefully peel the 1/32 slice of Earth. This tiny bit of peeling represents the surface, the very thin skin of the Earth's crust upon which humankind depends. It is less than five feet deep and is a quite fixed amount of food-producing land.

5. Explain that protecting our land resources is very important. Advanced agricultural technology has enabled the world to feed many of its people. But, with a fixed land resource base and an ever-increasing number of people to feed from that fixed base, each person's portion becomes smaller and smaller. It is essential to protect the environmental quality of our air, water and land.

Part 2: Shares of Mother Earth

Carrying capacity for each animal species depends upon the amount of natural resources available on a given area of land. For example, to raise one cow, you would need one acre (about the size of a football field) of very rich pasture land, or ten acres of range land, or 100 acres of scrub land.

Procedure:

Duplicate the Student Worksheet on pages 55 and 56 so that each student will have a copy. Have students answer each question on the worksheet. They may be instructed to work independently or in pairs or small groups. Then lead a class discussion of the answers (given below) and the extended learning questions.

Answers to Student Worksheet Questions:

1. All student estimates should be allowed, no matter how farfetched. For the sake of class discussion, the actual amounts of land needed for the animals listed are as follows:

   a. 1 acre.
   b. 1.2 acres.
   c. 32,000 acres, or 50 square miles.
   d. 38,400 acres (60 square miles) if it is male or 3,200-12,800 acres (5-20 square miles) if it is female.
   e. 8,000 pounds of fish (in a pond 40 feet deep at the center).
   f. There is no one right answer to this question, since different lifestyles would determine how much land a human requires. A wealthy American celebrity may require millions of acres to gratify his/her desire for fine clothes, food and homes, while a resident of a poor African village may only require two or three acres of land. According to Dr. Edward Passerini of the University of Alabama, 2.5 acres would be about the minimum amount of land that a human would need to survive.

2. a. Student estimate.
   b. How many people there are and how many acres of land there are on Earth.
   c. 5.7 acres.
   d. It will get smaller.

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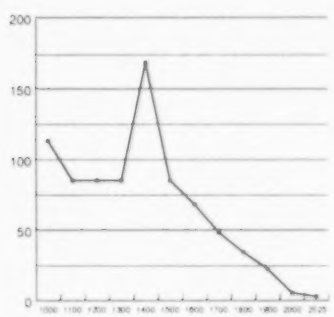
3. 1.7 acres of forest.
   1.5 acres of meadow.
   1.7 acres or wasteland.
   0.63 acres of farmland.
   0.17 acres of pond or swamp.

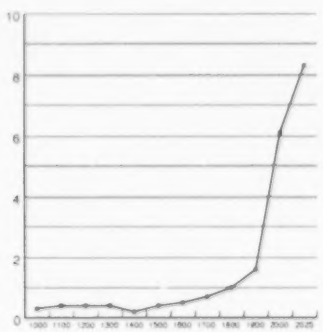
4.

Year	Number of People (in billions)	Acres/Person* (Rounded to nearest whole number)
1000	0.3	113
1100	0.4	85
1200	0.4	85
1300	0.4	85
1400	0.2	170
1500	0.4	85
1600	0.5	68
1700	0.7	49
1800	1.0	34
1900	1.6	21
2000	6.1	6
2025	8.3	4

* The U.S. Department of the Interior, Geological Survey estimates the total number of acres for the world's land mass, not including Antarctica, to be approximately 34 billion.

5.





Bonus question: 90,000,000 people (90 million)

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Discussion Questions:

1. How do you explain the dip in population between 1300 and 1500? What are some possible explanations for the sharp increase in population from 1800 to the present?

   The dip in population between 1300 and 1500 was largely due to the spread of the deadly bubonic plague (also called the Black Death). It killed about 75 million people in Europe and Asia. The sharp increase in population has been a result of advances in science and technology that have allowed people to live longer. These include better nutrition, sanitation, food production and modern medicine. At the same time, both rates have not dropped to the levels of death rates in most parts of the world.

2. How do you think the quality of life will change by additional increases in human population? How might it get better? How might it get worse?

3. As we use more and more land for the needs of people, what will happen to the animals and plants that are now living on the land? Why?

   As animal and plant habitats are used for human habitats, the populations of those other species are likely to decrease, creating more extinct and endangered species.

Part 1 originally appeared in *KUTATK*, a Native American Science Education Association publication.

Part 2 adapted with permission from Mike Weatherby, Kilo Junior High School, Federal Way, WA.

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Name: _____ Date: _____

WORLD REAL ESTATE
Student Worksheet – Page 1 of 2

1. How many acres of land do you think each of the animals below would require to accommodate all their needs for an entire life span? The acres could be jungle, grassland, pond or whatever your animal required. Remember, an acre is about the size of a football field and the animal must get all of its needs from its habitat.

   a) A cottontail rabbit needs_____ acres of land for a lifetime.
   b) A chipmunk needs_____ acres of land for a lifetime.
   c) An African elephant needs_____ acres of land.
   d) A black bear needs_____ acres of forest land.
   e) You could raise_____ pounds of fish in one acre of a deep pond.
   f) A human being needs_____ acres of land.

2. a) If we divided the entire land area of the world up into acres and gave every person on Earth an equal share of acres, how many acres do you think your fair share of land would be?_____.

   b) To determine the actual amount, what would you need to know?
   _____.

   c) If there are about 6 billion people on earth and the Earth contains about 34 billion acres of land, what is your fair share of land?_____ acres.

   d) What will happen to your fair share of Earth if the world's population continues to grow?
   _____.

3. Now that you know how much land you have, you also need to know what type of land it is. You can figure out how much of your land is forest, meadow, wasteland, farmland or pond by multiplying the decimal amount times your total acres. (For example: To determine how much farmland you have, multiply 0.11 times your total share of land.)

   If 30% of your land is forest,_____ acres are forest.
   If 26% of your land is meadow,_____ acres are meadow.
   If 30% of your land is wasteland,_____ acres are wasteland.
   If 11% of your land is farmland,_____ acres are farmland.
   If 3% of your land is pond or swamp,_____ acres are pond or swamp.

4. Find out how many acres of land people had in the past and how many acres people will have in the future for the following years. Remember, divide billions of people into 34 billion acres of land.

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Name: _____ Date: _____

WORLD REAL ESTATE
Student Worksheet – Page 2 of 2

YEAR	BILLIONS OF PEOPLE	ACRES/PERSON
1000	0.3	
1100	0.4	
1200	0.4	
1300	0.4	
1400	0.2	
1500	0.4	
1600	0.5	
1700	0.7	
1800	0.9	
1900	1.7	
2000	6.1	
2025	8.3	

5. Obtain two pieces of graph paper from your teacher. On one, graph population growth for each of the years listed above. On the other, graph land per capita for each of those same years. For comparison, make both graphs about the same size.

Bonus Question:

If the world's population of 6 billion is growing by 1.5%, how many additional people will there be after one year?

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People, Resources and the Environment

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The Balance Of Nature

Student Reading 2

In Part 1, we learned about how populations grow and that there are limits to how large a population can become, since we all need food, water, shelter and energy sources to survive.

It's important to remember that the Earth is a **finite system**. There will never be more water on Earth and in the atmosphere than there was a million years ago, or is now, so we must not pollute it. There is only so much land on which to grow food, trees and fibers for clothes, and to build houses and stores, so we must take care of it. There are only so many minerals and fuel sources in the ground, so once we use them up, that's it.

Protecting Biodiversity

Our planet is home to so many different kinds of life forms and we depend on this diversity in nature for survival. The many different plants and trees provide us with food, oxygen to breath, wood, paper, shade, medicine and more. Animals eat plants or smaller animals and some become food for us. While there are some animals we eat, most we depend on without even knowing it. What would happen, for instance, if there were no bees to pollinate the flowers? Or spiders to eat smaller bugs? Or worms to **decompose** plant life and make the soil rich for growing things? All of this **biodiversity** makes Earth the wonderful planet it is.

This is why it is important for the size of the human population to be in balance with the Earth's other creatures and with our natural resources. As the human population grows, people need more land for building houses, factories, roads, schools and shops and for disposing of waste. They also need to produce more food to feed more people. But the Earth is finite. Whatever land is being turned into human habitat is taken away from animal and plant habitat. The result is smaller populations of fewer species. Already, scientists estimate that 100 plant and animal species become **extinct** every day!

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Preserving Precious Land

Expanding human habitat does more than simply rob other species of homes. It can affect our planet's ecosystems and atmosphere in countless ways. For instance, each year, 27 to 28 million acres of forests (about the size of Pennsylvania) are cut down to create more farmland and obtain wood for fuel and other uses. The loss of these forests affect the entire Earth.

We all depend on forests, especially the tropical rainforests of Asia, Africa and Latin America, to control the world's weather patterns. Forests absorb the excess carbon dioxide (CO_2) released from burning fuels in our cars, homes and businesses. Carbon dioxide in the air traps more of the sun's heat, not letting it escape back into space. The trapped heat keeps the Earth warm like a greenhouse. Most **climatologists** think that people's increased use of **fossil fuels** is causing the average temperature of the world's atmosphere to rise. This "global warming" can cause serious climate changes, such as droughts in farm areas and flooding in low lying areas and coastal areas.

When trees absorb CO_2, they produce more oxygen for us to breathe. What's more, tree cover prevents rich soil from eroding. Wherever trees are removed, the soil loses the shelter of branches, leaves and roots that protect it from being blown and washed away. Topsoil is threatened in other ways as well. In search of food, growing numbers of people have expanded their livestock herds. These billions of animals graze the world's grasslands to dust without giving the grass a chance to regrow. Croplands, too, have been destroyed as the rich topsoil **erodes** after being overworked and misused.

Mining operations can also damage precious land. Our Earth is rich with minerals we rely on to produce so many products we use every day, from the building materials of our homes, cars and appliances to our food containers, tires, cleansers and art supplies. Some minerals are very common (like salt) and others are much rarer (like gold). As the human population grows, the demand for minerals grows as well. Minerals are **nonrenewable resources**. Once they are used up, they can never be replaced. Extracting minerals from the ground often destroys needed topsoil.

Conserving Energy

The way we live also affects the balance of nature. Every time we use energy by driving in a car, turning on lights, TV or other electrical appliances, we are using fuel. This might come from oil, coal or natural

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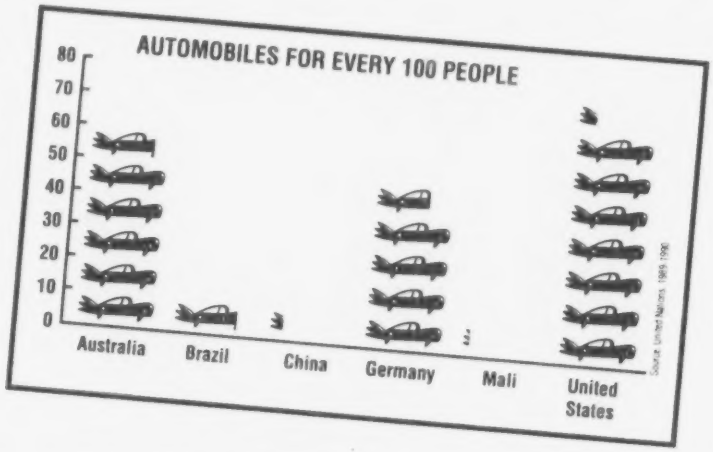
gas, which are all in limited supply underneath the Earth's surface. In one year, the average American uses energy equal to 45 barrels of oil, 15 times as much as the average Chinese. This is not surprising considering that Americans enjoy a high standard of living with many energy-powered conveniences, such as air conditioners, hot water, stereos and computers. There is one car for every two people in the United States compared to one car for 200 people in China!



Burning these fuels has a side effect — they create air and water pollution. There are cleaner ways of producing energy for homes and businesses, such as energy from the sun (solar), water (hydro) and wind. These forms of energy are becoming more efficient and could be common ways to produce energy power in the future. In the meantime, conserving energy by turning off appliances when not in use and walking, biking or carpooling can go a long way to reduce fossil fuel use.

Buying Less, Pitching Less

The way we consume items also affects our environment. The more we buy, the more there is to throw away, especially if an item has lots of packaging. On average, each person in the United States creates nearly four pounds of trash daily, more than people from any other country.

Most people don't give their trash another thought after they throw it away. But where is "away"? Garbage is usually put in landfills (big holes in the ground), or burned (creating more air pollution), or sometimes dumped into the oceans (making it nasty and hazardous for the fish). Some of our trash, such as food scraps, decomposes quickly in the ground. Some of our trash, however, includes plastic and styrofoam containers, which do not break down into the soil and can last thousands of years.

The less we buy and the more we are able

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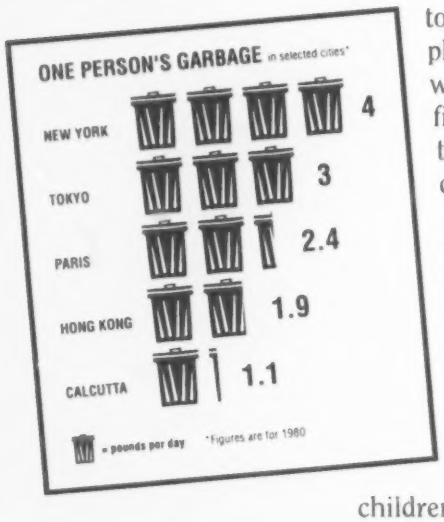

to reuse items or recycle them into other products, the better for the planet. Otherwise, we're stuck with more and more garbage that won't go away as the number of people increases. Already our landfills are filling up and we are not able to build new ones fast enough to dispose of all our waste. Besides, no one really wants new trash dumps built close to his/her neighborhood.

Sustaining a Healthy Planet

It may seem like we still have plenty of **natural resources**, open land and species on the planet today. What about in the years to come? By having a balance of people and natural resources and protecting other species, we can work to **sustain** a healthy planet and good quality of life for all. This means only using what we need, so that we can leave plenty for our children and their children. Trees that are cut down must be replaced. Waterways should be kept free of pollution. Energy resources should be conserved, while we develop cleaner and more efficient energy sources for the future. And we must be aware that if the human population continues to grow rapidly, we will tip the balance and not be able to sustain our life support systems.

Reading Comprehension and Analysis:

1. Name two ways that human population growth can affect the habitat of other species.

2. What are two practices that can destroy the topsoil needed to grow crops?

3. Do you think that the American lifestyle puts a greater strain on the Earth's environment than lifestyles in developing countries? Why or why not?

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Glossary:

biodiversity: the variety of species in nature and the genetic diversity within each species.

climatologists: scientists who study climates.

decompose: break down into smaller pieces.

erosion: the wearing away by water or wind.

extinct: no longer existing. When a plant or animal species dies off, we say it is extinct.

finite system: a system of resources in limited supply. The resources can be reused or recycled (like water), but you can never make more. All matter is created from other matter already in the system.

fossil fuels: nonrenewable energy sources found beneath the surface of the Earth (oil, natural gas and coal).

natural resources: raw materials supplied by nature.

nonrenewable resources: a resource from the Earth in a limited supply that cannot be regenerated, such as a mineral.

sustain: to prolong or maintain.

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ACTIVITY 11

Everything Is Connected

Concepts:
In nature, everything is connected to everything else. Human population growth, for example, is a factor that can have far-reaching effects on the environment and society.

Objectives:
Students will be able to:
▶ Identify possible environmental, social, political and economic effects of a growing world population.
▶ Create a concept map within a cooperative learning group or as a class to illustrate these cause and effect relationships.

Subjects:
Science, Social Studies

Skills:
Drawing connections, explaining cause and effect relationships, working in a cooperative group, concept mapping

Method:
Students identify ways that many factors in human society and the natural environment are interdependent by creating a concept map or "future wheel" as a class or in cooperative learning groups.

Introduction:

"Everything is connected to everything else" is often called the First Law of Ecology. This activity encourages students to consider the connections between aspects of our natural environment and human society.

Materials:

Chalkboard and chalk
or
Large pieces of butcher paper/flip chart paper
Markers
Tape

Procedures:

1. Write the words "More People" in the middle of the chalkboard. Tell students that you want them to think of what might be the environmental, economic or social impacts of there being more people. You may want to provide an example, such as... "more people"... might mean "more cars on the road" or "more houses." Next to "More People," draw an arrow and add one of these concepts. Be sure to tell students that there are no right or wrong answers, but you may ask them to explain their proposed connections. Also, let them know that the cause and effect relationship can be positive, negative or neutral.

2. Invite students to come up to the board, a few at a time, to add to this word web. They may add on to the central concept, "More People," or add on to what someone else may have contributed. For each concept that a student adds, he/she should draw arrows to any of the other concepts that form a cause and effect relationship. The object is for the class to create a large and interconnected web.

3. After all of the students have had a chance to contribute to the web and have taken their seats, walk them through the web, starting from the middle. You may wish to ask individual students to explain their additions to the web and to see if other members of the class agree or disagree.

Alternative Procedures:

Instead of having students create one large future wheel on the chalkboard, divide students into groups of three or four and distribute butcher paper and markers to each group. As cooperative groups, they will construct their future wheels, filling the paper as completely as possible. Then have each group tape up their future wheel and allow time for students to view each group's work. You may want to have a representative from each group explain some of the cause and effect relationships on their wheel.

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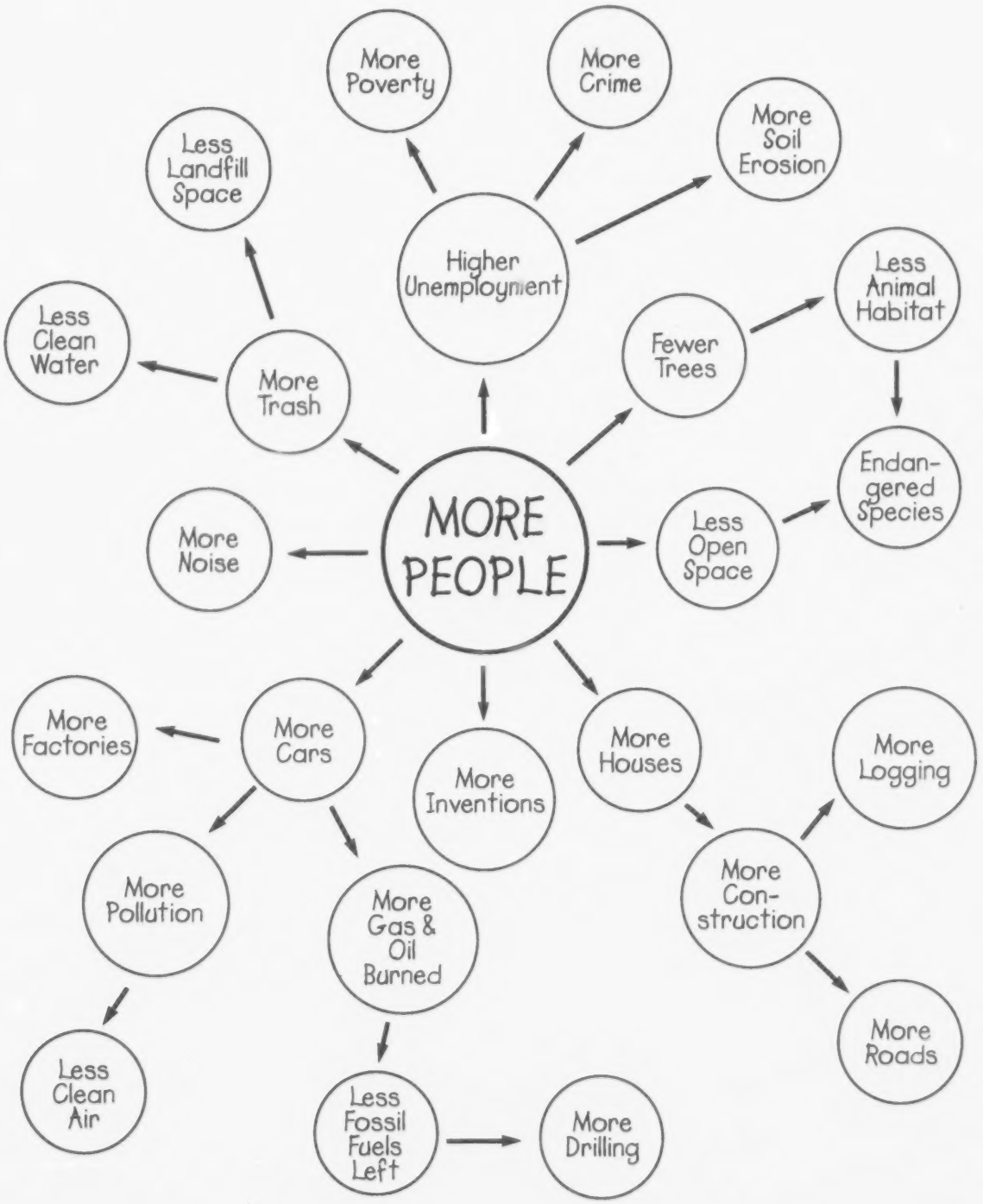
Future Wheel Sample



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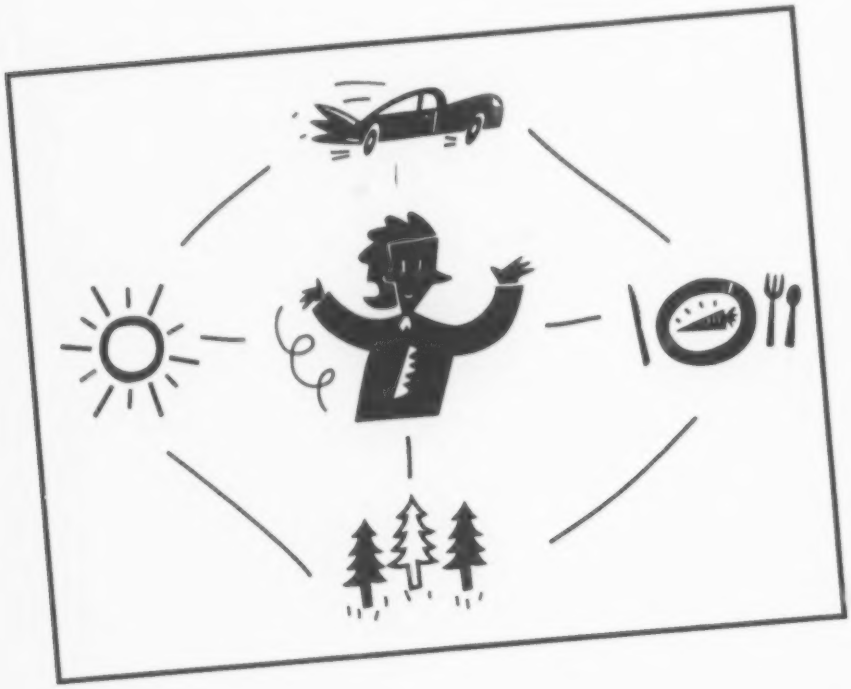
Follow-up Activity:

Using cut-out pictures from magazines, students can recreate their word web into a visual display on poster board or a classroom bulletin board. This way, the activity can be shared with other students in the school and with parents and community members for special event nights.



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ACTIVITY 12

A World Of Difference

Introduction:

As human populations grow, we require more human habitat for homes, roads, farmland, etc. To create more human habitat, we use land that has been home to other species of plants and animals. This can alter the delicate web of life, whereby each species depends on other species to survive.

It is estimated that there may be as many as 30 million plant and animal species worldwide, although only 1.4 million have been named. Over half of all species make their homes in the tropical rainforests of Asia, Africa and Latin America. Within four square miles of rainforest, a person may find over 750 species of trees, over 1,500 different kinds of flowering plants, 125 different mammals, 400 kinds of birds, 100 reptiles, 60 amphibians and countless insects — including 150 types of butterflies! This variety not only adds to the beauty and richness of our planet — it is also critical to human health and survival for many reasons. People depend on other species for food, medicines, industrial products and such "ecological services" as water purification, nutrient cycling and pollination. One-quarter of all drugs that doctors prescribe in the United States contain a natural compound, often from the rainforest.

The rate of deforestation, and therefore habitat loss, is now greatest in the tropical rainforests, where people cut down 26 million acres (an area about the size of Pennsylvania) each year. That's 50 acres per minute! Forests have been cut down so that the land can be used for agriculture as there are more and more people to be fed. Even so, this land is not well-suited to farming as the nutrient-rich topsoil in the rainforests soon blows away when there are no more tree roots to hold the soil in place, leading to desertification. Population growth has also created an increasing demand for timber, for everything from chopsticks and paper to housing and furniture. Wood is the major source of energy in developing countries where population growth rates are highest.

Materials:

1 1-dozen egg carton per student
1 10 oz. bag each of dry pinto beans and red beans
1 20 oz. bag of 15-bean soup mixture
Optional: Just a few of some of the following — peppercorns, coffee beans, pearl tapioca, barley, sunflower seeds, yellow and blue popcorn kernels, apple and citrus seeds, cloves, whole nutmeg, chick peas, pinenuts, pumpkin and watermelon seeds, fennel and caraway seeds etc.
2 plastic containers
2 tablespoons
1 pair of dice
Student Worksheet (one per student)

Concepts:
Biodiversity is important both for maintaining the health and beauty of our planet's ecosystems and the survival of all species, including humans. Unfortunately, human population growth threatens to undermine the diversity of life on which we all depend.

Objectives:
Students will be able to:
▶ Define biodiversity.
▶ Compare and contrast the biodiversity of a U.S. temperate forest with a tropical rainforest.
▶ Explain the impact of human population growth on the biodiversity of these two ecosystems.
▶ Hypothesize how people and ecosystems would be affected if certain species did not exist.
▶ Research a rainforest species and artistically represent its importance (optional).

Subjects:
Science, Math, Art, Social Studies

Skills:
Observing, counting, analyzing data, critical thinking, researching, visual arts

Method:
Through a simple simulation and subsequent discussion, students learn what is meant by "biodiversity," why it is important and the impact human population growth can have on biodiversity.

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Part 1: Spilling the Beans on Biodiversity

Procedure:

1. Mix the pinto beans and red beans together in a container. Pre-measure beans, ensuring that there is 1 Tbsp. per student.

2. Place 15-bean soup mixture (plus optional items if you desire) in another container. Again, pre-measure beans, ensuring that there is 1 Tbsp. of beans per student.

3. Give each student an egg carton. Have students open their egg cartons and number the "pockets" 1-6 near the hinge of the carton top. Each egg pocket = 1 acre of land. One row of 6 pockets equals 6 acres of temperate forest that you might find in or near your own community in North America. The bottom row equals 6 acres of tropical rainforest as in Costa Rica, Brazil, Africa or Asia. Have the students number these pockets 1-6. Have the students label the top row, "North American Hardwood Forests" and the bottom row, "Tropical Rainforests." (See page 72.)

4. Pass around the container that holds the combined pinto and red beans. This mixture represents the relative biodiversity of a U.S. temperate forest. Have each student scoop out 1 Tbsp. and randomly scatter beans along the top row of egg pockets in the carton. Be sure not to get any into the lower row of pockets, as this is the ecosystem for the tropical rainforest.

5. Circulate the container that holds the 15-bean soup mixture. This mixture represents the biodiversity of the tropical rainforest. Have students repeat the same sequence as above, scattering the beans in the other row of 6 acres, making sure not to "spill the beans" in the top row of U.S. forest acreage.

6. Now instruct students to fill in the chart provided on the Student Worksheet to tally the biodiversity of each acre by counting, identifying and writing down:

   a. the number of different kinds of beans (species) and

   b. the total number of beans in each species.

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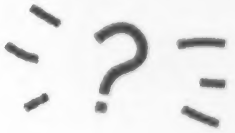
Discussion Questions:



1. What basic observations can be made from the U.S. temperate forest biodiversity data and the tropical rainforest data?

   For the U.S. forest, there are lots of each kind of bean. Almost every acre has at least one of each bean. In the tropical rainforest, each acre is very different in bean composition — no two acres are exactly (even closely) alike.

2. What do these beans represent in each forest?

   The two different beans in the U.S. forest represent common plants and animals found in those woods. Of course, there are many more kinds of species. A 2:15 ratio was used to simplify the activity (and because there are only so many different kinds of beans in the grocery store). In an average acre of U.S. forests, there may be hundreds, or even thousands, of plant and animal species. Have the students suggest what species might be represented in their local woods. For instance, Loblolly Pine Trees (pinto beans) whose pine seeds are eaten by Blue Jays (red beans); Gray Squirrels (pinto beans) who nest in the cavities of mature White Oak Trees (red beans), etc.

   The 15-bean mixture (and whatever you might add to it) represents the many different kinds of flora and fauna found in the tropical rainforests. Leaf-cutter Ants (lentils) that live in partnership with certain Fungi (baby lima beans) that grow nowhere else in the world except in leaf-cutter ant colonies; Poison-Arrow Frogs (blackeye peas) that lay their eggs in the water pools of Bromeliads (black beans); Hummingbirds (yellow split peas) that drink the nectar of, and, in the process, pollinate Passion Flower Vines (green split peas); Rainforest Algae (small white beans) that grow in the hair grooves of the Three-toed Sloth (kidney beans), camouflaging the animal in a green fur coat; Wild Avocados (pearl barley) that bear the favorite fruit of Quetzal Birds (cranberry beans); hungry Jaguars (large lima beans) that pounce on their prey from tall Kapok Trees (garbanzo beans), etc.

Your students may note that the "decks were stacked" in this activity. In truth, a 2:15 bean ratio does not even reflect the overwhelming percentage of rainforest species. Even though rainforests occupy less than 7% of the Earth's surface, over half of all living things are found there. Take trees for example: A tropical rainforest contains an average of 20-86 tree species per acre compared to about four tree species per acre in a temperate zone forest in North America. The reason that tropical rainforests have a higher biodiversity is that they are believed to be the oldest land-based ecosystem on Earth. They have probably been around for about 60 million years, which is plenty of time for so many species to evolve to fit every available niche. Also, the warm climate and humidity keeps plants and animals from expending their resources on harsh winter survival. Costa Rica, though only the size of West Virginia, has more species of trees and birds than are found in all of North America!

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Part 2: What Have Humans Bean Up To?

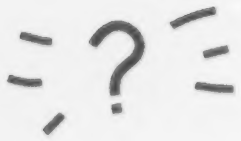
Procedure:

Now let's see what happens when humans destroy the forest to create something else (houses, farms, ranches, timber operations, power plants, roads, etc.) Suppose two acres of both the temperate forest and the tropical rainforest are clear-cut, slashed and burned, or otherwise deforested.

1. Ask a student to roll the dice to determine which two acres are cleared (Example: Acres #2 and #5 or acres #1 and #4).

2. Instruct students to carefully remove ALL species from those acres on their egg cartons.

3. Ask students to look at their tallies written earlier, and to determine which species are negatively affected.



Discussion Questions:

1. How is biodiversity affected by human activity in the U.S. forest? In the tropical rainforest?

   In the U.S. forest, there was a decline in the number of both species, but they still exist in the other acres that were not destroyed. In the tropical rainforest, there was significant loss of biodiversity. Some species were rare to begin with and their numbers have been further reduced. Some species may have only existed in the acres that were cut. Many rainforest species are vulnerable to extinction because they depend on other species in extremely specific ways. Whenever this kind of partnership exists, the extinction of one species often leads to the extinction of other species.

2. Can you think of ways that people could benefit from the richness of the rainforest without cutting it down? (Hint: What are some things we value that are grown in the rainforest?)

   Biodiversity is immensely valuable, but this value is often not recognized. For example, the value of nontimber goods the forest provides — the fruits, nuts, resins, oils, medicinal plants and tree bark, and subsistence food — are ignored in economic assessment of forest use, but studies show their value may far exceed that of timber.

Part 3: What If?

Procedure:

Divide students into groups of four or five and give each group one of the discussion questions on the Student Worksheet. Allow the groups 10 or 15 minutes to discuss these "What If?" questions that help them explore the importance of biodiversity. Ask each group to jot down the three most important points in their discussion. When you bring the class back together, have each group present their question and the highlights from their discussion.

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Follow-up Activity:

Biodiversity: The Treasure Chest of Life

Now that your students have begun to understand the importance of maintaining the planet's biodiversity, they can have a hand in educating others. Ask students to think of biodiversity as the "treasure chest of life" where each and every living thing glitters like a precious genetic gem. You can now put this thought into a 3-D display.

1. Borrow a trunk, like the kind you or one of your students might have in an attic, or have students decorate a big box to look like an old trunk.

2. Have each student research an obscure plant or animal found in a remote tropical rainforest like the rosy periwinkle found in Madagascar. Lots of books and magazines with rainforest information are available for background reading in libraries. Back issues of *National Geographic*, *Ranger Rick* and other wildlife magazines are good sources.

3. Take empty food boxes (cereal, detergent, etc.) of all different sizes and shapes and wrap them in recycled paper that has been artistically decorated with colorful illustrations of the rare plant or animal. Students could collage, paint, draw or stick "Sculpey" onto the box to decorate it. They could also glue leaves, twigs or grasses onto the box.

4. Wrap the box with leftover holiday ribbons and bow. Have students choose the most exciting "gift" their plant or animal offers the world and write it on a gift tag. How is it unique? Why is it truly precious? It's O.K. for a life form to exist just because it does, not just for the benefits to other species.

5. Put all "gifts" of biodiversity into the trunk. Place it in the school lobby and let people touch and read the gifts. You'll be sharing the gift of knowledge about biodiversity!

Parts 1 and 2 and the Follow-up Activity adapted with permission from Sheila Jones, Wake Soil and Water Conservation District, Raleigh, NC, as printed in *The Conservation Catalyst Newsletter*, Winter 1993-94. Part 3 adapted from "Biodiversity What Ifs?", from *Community Connections*, Oakland Museum of California, 1992.

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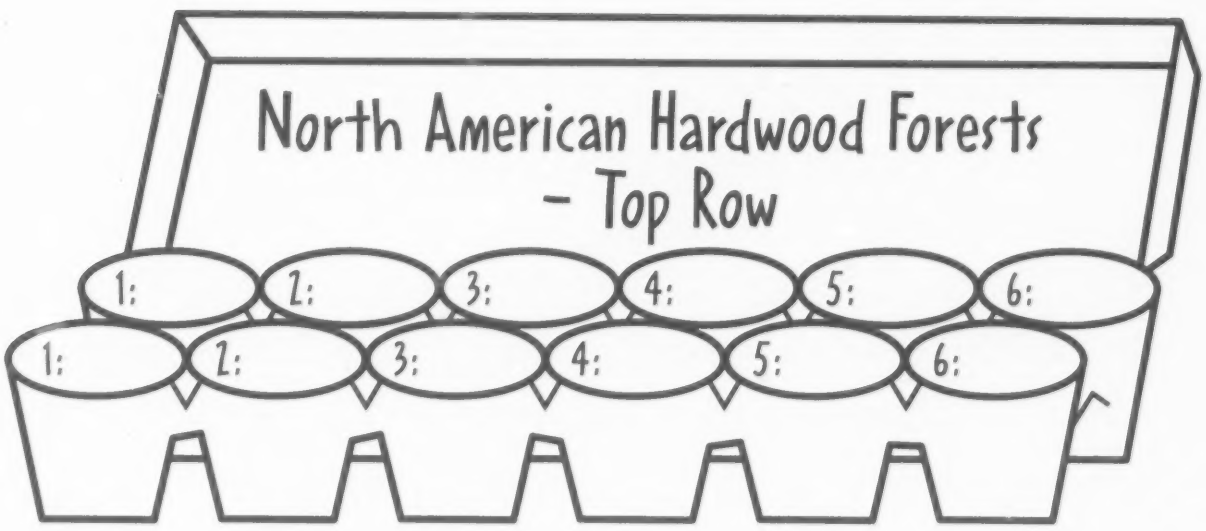
Name: _____ Date: _____

A WORLD OF DIFFERENCE
Student Worksheet – Page 1 of 2

For each pocket in the egg carton, tally the number of:

a) different kinds of beans
b) number of each kind of bean



Tropical Rainforests - Bottom Row

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Name: _____ Date: _____

A WORLD OF DIFFERENCE
Student Worksheet – Page 2 of 2

1. What would the world be like if no organism existed that decomposed (broke down into small pieces) dead things?

2. How would you feel if all the lions, tigers and bears in the world went extinct? If all the slugs, snails and worms went extinct? Which do you think would have a greater effect on your life? On the health of other animals and plants? Do these animals have dollar values that we can calculate and compare? What values do they have that we cannot put a price tag on?

3. Name as many objects in your homes as you can think of that come from a plant or an animal. Name 10 jobs that depend on plants. Can you think of any jobs that do not depend on any plant material?

4. There is a native plant that grows only in the area around your community. A particular butterfly will only lay eggs on this plant. Its roots are an important food for a species of native gopher, which in turn is a major food source for local hawks and coyotes. A group of your neighbors wants to plow the fields that contain the last of the plant to build a golf course. What would be your arguments for or against plowing the fields? Would your arguments be different if, instead of a golf course, the land were being developed for housing for low-income families, or for a factory that would give 200 people jobs, or for a retirement home for senior citizens?

5. Even within the human species, there is a great deal of diversity. What if this racial and cultural diversity did not exist? What would our world be like if all people looked and acted alike and shared the same views? Can you think of ways that diversity among people is essential for human survival, just as biodiversity is essential for ecological survival?

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ACTIVITY 13

Timber!

Concepts:
With continued population growth and inadequate planning, renewable resources, such as trees, are often used faster than they can be replaced.

Objectives:
Students will be able to:
- ▶ Complete a chart, calculating the number of trees being planted and cut in a forest as demand for wood increases.
- ▶ List ways that forests can be preserved and what individuals can do to conserve tree products.
- ▶ Write a short poem about the importance of trees (optional).

Subjects:
Math, Science, Social Studies, Language Arts

Skills:
Adding, subtracting, working in cooperative groups, interpreting data, poetry writing

Method:
In this role-playing simulation, students observe what happens to a forest when the demand for wood is greater than the supply.

Introduction:

People rely on wood from trees to heat their homes, cook their food and provide building materials and paper for homes, schools and businesses. The more people there are, the greater the demand for wood. While it takes only seconds to cut down a tree, it takes years to grow a new one. We also depend upon forests to regulate climate, clean air and water, conserve precious soil and provide homes for many birds and animals. In almost every part of the world, trees are being cut down at a faster rate than they are being replaced.

Materials:

For each group of four students you will need:
120 craft (Popsicle) sticks in a coffee can with a rubber band around them
32 craft sticks in a rubber band
Stopwatch or clock with a second hand

Procedure:

1. Divide the class into groups of four students. For each group, assign the following roles: lumberjack, forest, forest manager, timer.

2. Give 120 craft sticks in a coffee can to each student representing the forest. These sticks represent the supply of trees available to the lumberjack for cutting.

3. Give 32 craft sticks to the students representing the forest managers. These sticks represent trees that will grow during the game.

4. The lumberjack records the transfer of trees each minute on a chart like the one illustrated.

Minutes	Number of trees at beginning of minute	Number of new trees	Number of trees cut	Number of trees at end of minute
1	120	+4	-1	123
2				
3				
4				
5				
6				
7				
8				

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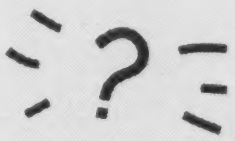
5. Begin the game when the timer gives the signal. After 15 seconds, the timer tells the forest manager to give the forest one tree. Every 15 seconds for the rest of the game, the forest manager adds another tree to the forest. In doing so, the forest manager simulates the average rate at which trees grow to maturity and become timber reserves in the real world.

6. Stop at the end of the first minute of the game and let the lumberjack remove one tree from the forest. The tree represents the amount of wood the world needs for heating, cooking and building materials at its present population.

7. Continue the game. At the end of each succeeding minute, the world's demand for wood doubles as a result of a growing population. At the end of the second minute, the lumberjack cuts two trees from the forest; at the end of the third minute, the lumberjack cuts four trees from the forest, and so on.

8. End the game when the wood reserves in the forest can no longer meet the demands of the lumberjack.

Discussion Questions:



1. How many minutes did it take for the lumberjack to cut all the trees in the forest?

   Just over seven minutes. At seven minutes there would only be 21 trees left.

2. Was the forest always shrinking? Explain.

   No. After the first minute, the forest increased by two trees and stabilized for another minute. After the third minute, the doubling of forest use led to the end of the forest.

3. If the forest manager could develop a tree that grows at a rate of one tree per second, would tree growth keep up with the timber demand? Why not?

   No. The doubling of forest use due to increased population size would still lead to the demise of the forest. If the simulation was done with 60 sticks given to the forest each minute, it would only increase the life of the forest by two more minutes.

4. What could be done to prevent the demise of the forest?

   The forest can be maintained only if we cut down what can be replaced and no more. This means conserving our use of tree products such as paper and lumber. However, if the human population continues to grow, so will the demand for these items.

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Follow-up Activities:

1. Poet Ogden Nash wrote the following verse to describe his feelings about the beauty of trees and the danger they are in:

"I think that I shall never see
A billboard lovely as a tree.
Indeed, unless the billboards fall,
I'll never see a tree at all."

Invite students to write their own short verse about trees. This could be in the form of a limerick, haiku or any other rhyming or nonrhyming verse.

2. Lead a brainstorming session with students on ways to conserve paper at home and in school in order to save trees. Write these on the board and try to implement the more practical ideas in the classroom, such as using both sides of paper.

3. Help students organize a schoolwide tree-planting day, where trees are planted on the school grounds. For more help in organizing such an event and securing saplings, contact a local nursery (which may wish to sponsor the event for great community publicity). Or, contact The National Arbor Day Foundation at 211 North 12th Street, Lincoln, NE 68508; (402) 474-5655 for more information.

Timber! originally appeared in *Two Cans and Toucans: Exploring Shrinking Habitat* developed by Biological Sciences Curriculum Study (BSCS), Colorado Springs, CO, for The National Science Foundation's National Science and Technology Week packet, ©1990.

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ACTIVITY 14

Water, Water, Everywhere

Introduction:

Though water is a recyclable resource (we can, to some degree, clean and reuse it), it is not a renewable one (we will never be able to create more of it). Unlike some other nonrenewable resources, water is absolutely essential for life. Science might be able to provide us with alternatives to gasoline, for example, but there is no substitute for water. We must be careful in the ways we use and treat it.

Although 75 % of the planet is covered with water, only a very small fraction is available for human use. Of the water that is available to us, some becomes contaminated from human actions, such as toxic run-off from agriculture, factories, or pollutants that we dump into the water supply from our sinks at home.

Population growth over the past 30 years has caused demand for water to double in about half the countries in the world. Residents of states with rapidly growing populations, such as Florida, Arizona and California, as well as citizens of other countries, are dealing with this dilemma on a daily basis, and often experience water shortages.

In addition to all of the water we use directly in our homes, we also use water indirectly to power electricity, irrigate farms and manufacture products. Americans consume an average of 1,600 gallons of water per person each day for these direct and indirect uses, more than three times that of the average person in Europe. In the following activity, students will gain an appreciation for the ways we use water and the need to conserve it.

Materials:

7 clear containers
(2 one-liter containers; 5 smaller containers, one of which is plastic)
1 plate
Overhead projector
Masking tape
Marking pen
One liter of water
Salt (34 grams)
Sand (approximately 250 ml)
Blue food coloring
1000 ml graduated cylinder
One eye dropper
Graph paper
Calculators (optional)
Student Worksheet (one per student)
Student Information Sheet (one per student)

Concept:
Although water covers three-quarters of the Earth, only a small fraction is available for human consumption. As the population grows, water efficiency and conservation become more important.

Objectives:
Students will be able to:
- Identify what percentage of the world's water is available for human use.
- List many of their direct and indirect uses of water.
- Identify ways to conserve water in their daily lives.

Subjects:
Science, Math, Family Life Education

Skills:
Estimating, graphing, calculating, metric measuring, observing, researching, writing

Method:
Students observe a brief demonstration on the distribution of the world's water and then calculate how much water they use on a daily basis, both directly and indirectly.

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Part 1: Only a Drop to Drink

Procedure:

Set-up:

1. Gather all materials.

2. Fill one small container with sand.

3. Fill a one-liter container with water, add 4 drops of blue food coloring and stir.

4. Label the other 5 containers as follows:
   —a one-liter container "oceans"
   —a small plastic container "polar ice"
   —a small container "deep groundwater"
   —a small container "fresh water"
   —a small container "other"

5. Measure and set aside 34 grams of salt.

Facilitating the Activity:

1. Display the seven containers prepared for this activity.

2. Distribute copies of the Student Information Sheet. Explain that one liter contains 1,000 milliliters and that the graduated cylinder is one liter. Ask students to tell you how to distribute the one liter of water into the five empty containers according to the percentages indicated in Figure 1 on the Student Information Sheet. (97.1 percent of the water on Earth is found in the oceans. 97.1 percent of one liter is 971 milliliters. Therefore, pour 971 milliliters into the container marked "oceans.")

3. After you have filled the empty containers with the appropriate amounts of water, continue with the demonstration as follows:

   a. Add 34 grams of salt to the "ocean" container; this will match the salinity of the water sample with the salinity of the earth's oceans (3.5 percent).

   b. Set the "polar ice" container and the "other" container aside. We do not have access to this water.

   c. Pour the "deep groundwater" into the container of sand.

   d. Ask the students which of the containers represents fresh water that is readily available for human use. (They should easily see that only the jar marked "freshwater" has the readily available supply.) Initiate a discussion on the limits of freshwater supplies, the problems of population growth and distribution, and the contamination of existing supplies. Only a small part of this freshwater is accessible. The rest is too remote (found in the Amazon and Siberian rivers) to locate, too expensive to retrieve or too

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polluted to use. Hold a plate in front of the class and dramatically drop the usable portion of fresh water onto it. (Represent this portion as one drop of water from an eye dropper.)

Part 2: Water Use Audit

Procedure:

1. Have students record how many gallons of water they think they use individually in an average day. Later, they will compare this estimated daily water use with their calculated daily water use.

2. As a group, have them list all the ways members of their class use water on a day-to-day basis. Distribute copies of the Student Information Sheet and Student Worksheet.

3. Using the data in the table, "Domestic Uses of Water," have them determine their individual water use per day for each activity that the class listed in Step 2. They should include their share of general family uses such as dishwasher and washing machine. Then they can determine their individual total water use per day.

4. Students should compare the individual water use calculated in Step 3 with the water use estimated in Step 1. Are their calculated figures higher or lower than their estimated figures? Ask students whether they consider themselves typical water users. Have them explain their answers.

5. Students should now draw a bar graph to illustrate how much water is used by their class for each activity. Which activities require the most water? Using the class average, students should also calculate the average use of their town and/or state.

Answers to Student Worksheet Questions:

1. Water is needed to grow the food and grasses the calf would consume.

2. Student answers will vary.

3. Student answers will vary.

4. Possible answers include purchasing and eating foods that require less water to cultivate (eating lower on the food chain); recycling items to prevent excessive use of water in manufacturing; driving less.

5. Possible answers include taking showers instead of baths; not letting water run while brushing teeth or shaving; fixing leaky faucets; installing water-saving devices for toilet and shower; watering lawn less frequently; and running dishwasher and washing machine only when you have full loads.

6. Student answers will vary. For further information on water contamination, you may wish to contact the U.S. Environmental Protection Agency, Public Information Center, 401 M Street, SW, Washington, DC 20460; (202) 829-3535.

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Follow-up Activities:

1. Have students investigate new household products that conserve water (such as low-flush toilets, new shower heads, timed sprinklers, etc). Each student or group of students could be responsible for writing up a brief synopsis of the costs and benefits of one or two of these products.

2. Have students read their home water meters daily for a week, at the same time each day, and report back to the class. They can then compare these readings to their estimates of daily water use. They can then read the meter for a second week, during which they implement many of the conservation measures suggested above.

Part 1 adapted with permission from the National Science Foundation. The original activity appears in the *National Science and Technology Week Activity Guide, 1988* by the National Science Foundation, Washington, DC.

Part 2 adapted with permission from Biological Science Curriculum Study. The original activity appears in *Biological Science: An Ecological Approach* (Kendall-Hunt Publishing Company, 1987).

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Name: _____ Date: _____

WATER, WATER, EVERYWHERE
Student Information Sheet

DOMESTIC USES OF WATER

Activity	Gallons Used
Brushing teeth	2-10
Washing hands	2
Shaving	20 (2/min.)
Showering	20-25 (5/min.)
Tub bathing	25-35
Flushing toilet	3.5-8
Getting a drink	0.25
Cooking a meal	5-7
Washing dishes by hand	30 (8-10/meal)
Automatic dishwasher	15
House cleaning	7
Washing machine	24-50
Watering lawn	10/min.
Leaky faucet	25-50/day
Faucet and toilet leaks in New York City	757 million gallons/day

INDIRECT USES OF WATER

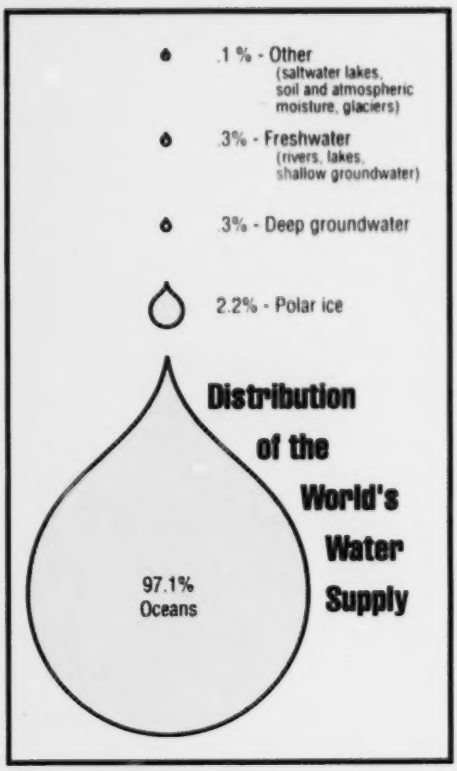
Agricultural

Item	Gallons Used
1 egg	40
1 orange	100
1 ear of corn	76
1 loaf of bread	142
1 kg flour	165
1 kg sugar	275
1 kg rice	1,101
1 kg beef	5,507

Industrial

Item	Gallons Used
Industrial mining/manufacturing	183/person/day
Cooling water for electric power plants	700/person/day
1 gallon gasoline	26-95
1 kg steel	77
Sunday newspaper	280
1 kg synthetic rubber	660
1 kg aluminum	2,202
1 car	94,825

Figure 1



From *Living in the Environment*, Third Ed., by G. Tyler Miller, Jr. © 1982 Wadsworth, Inc.

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Name: _____ Date: _____

WATER, WATER, EVERYWHERE
Student Worksheet

1. There are many water uses that are not obvious to most people. Consider, for example, that 1.2 million gallons of water are needed to raise one calf until it is fully grown. Why do you think so much water is needed to raise a calf?

2. Make a list of the ways you use water indirectly, for example, in the production of food you eat or materials you use.

3. Compare your list with the table on the Student Information Sheet, "Indirect Uses of Water." How many of these uses did you list?

4. How could you reduce your indirect use of water?

5. What could you do to reduce your direct use of water?

6. Is there any evidence that the water supply you use daily is decreasing in size or is being contaminated by pollutants? How could you go about obtaining this information?

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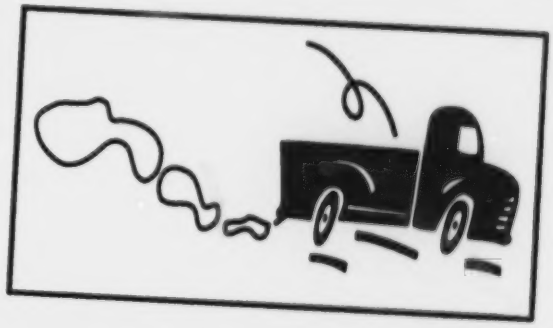
ACTIVITY 15

Transportation Tally

Introduction:

In the United States the automobile is a national passion. There is almost one car for every two people (including children) and close to four million miles of public roads. With over 140 million cars on American roads and the number growing every year, it is no surprise that every city in the country experiences traffic congestion. Americans' dependence on cars has increased even faster than population growth but has gone unquestioned despite the evident consequences.

In this activity students will see that cars draw on our fuel supplies, create pollution and change the character of communities. While improvements have been made, cars continue to be a major source of air pollution and prime contributors to global warming. In the United States automobiles account for 53% of all carbon monoxide (CO) emissions, 30% of nitrogen oxides and 27% of hydrocarbons emitted to the air.[1] All of this adds up to more smog above our cities and dirtier air for each of us to breathe. When gasoline is burned, carbon dioxide is released into the air. **Carbon dioxide (CO_2)** is one of the primary gases that causes the "greenhouse effect." Nationwide, the production and use of automobiles account for 30%[2] of all the carbon dioxide released from fossil fuels. The more people there are on Earth driving fossil fuel burning cars, the more pollution will be generated and the quicker our energy supplies will be depleted.



We usually build or widen roads to relieve traffic congestion, but this makes way for more cars and more congestion. Expanding roads and parking lots paves over and divides open space, animal habitat and pedestrian-friendly community areas.

In order to balance the continuing trends of population growth and desire for cars with the limits of the environment, planners, engineers, government regulators and residents need to develop creative solutions.

In other countries, people clearly make better use of buses, trains, bicycles and walking. In Europe only 40% of urban residents use cars while 37% use public transportation. The remaining 23% of the people walk or ride bicycles. In Tokyo, Japan, only 15% of people use cars to get to work. In comparison, residents of New York City, which has a comprehensive mass transit system, still use cars for two-thirds of all work-related trips.

Concepts:
The American dependence on cars creates problems for the environment and community.

Objectives:
Students will be able to:
- Complete math word problems about cars, congestion, gasoline use, and carbon dioxide.
- Describe the environmental impacts of driving.
- Suggest ways to decrease the effects of transportation on the environment.

Subjects:
Math, Social Studies, Science

Skills:
Analyzing data, identifying problems, brainstorming, multiplying, dividing, comparing numbers, calculating growth rates, converting units of measure

Method:
Students assess the natural resource use, pollution and community impacts associated with our population's driving habits through a series of math word problems, and they develop suggestions to meet the transportation challenges of the future.

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Some innovative city planners look at the reasons behind each trip to see if changes in community layout could reduce the need for transportation altogether. For example, in Portland, Oregon, officials found that projected energy consumption could be reduced by 5% simply by reviving neighborhood grocery stores[3]. Telecommuting from locally centered offices or homes is another option being explored.

Even if we lessen the car's impact on the environment, population growth will still create a demand for more cars, which still translates into more traffic, paved areas, etc. Today's students will be called upon to meet these challenges in the coming decades. The following activities encourage them to explore some of these "car troubles" and think about possible solutions to our "overdriven" society.

Materials:

Student Worksheet (one per student)
Calculator (optional)
Newspapers and magazines with advertisements

Procedure:

On the worksheet, students must solve word problems about cars. First, go over the information in the Introduction with your students. You may want to review the definitions of millions and billions before they embark on these tasks.

Optional warm-up activity:

Have students use a newspaper or magazine to find and cut out five adjectives that are used to describe cars or driving. Have the class make one big collage of these car images, noting whether each adjective came from an advertisement, news article or editorial. Ask them whether these adjectives suggest that the automobile is a national passion, a problem, or neither. At the end of the activity you may want to have them make another collage of their own images of car use in America.

Answers to Student Worksheet Questions:

Driving to the Limit

1. There were 1.8 people for each car in the United States in 1993.

2. a. In the 1930s, car, oil and tire companies bought up the city's electric trolley lines, and took them out to eliminate the competition from public transportation. *(Other guesses encouraged.)*

   b. It would take someone in the Los Angeles area 2/3 hour, or 40 minutes to get to work if he/she were traveling 20 miles at 30 mph.

   c. It would take that same person 80 minutes to get to work if he/she could only travel at 15 mph.

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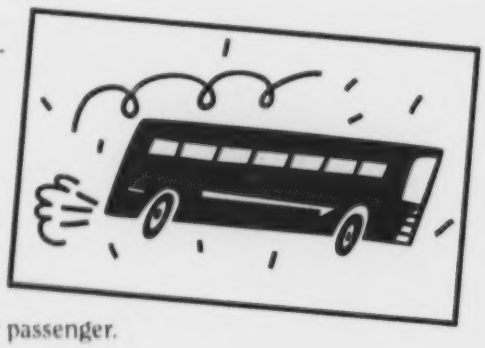
d. The difference in time between the two speeds is 40 minutes, or twice as long.

e. Student's interpretations will vary depending on whether they think population growth and use of cars will increase faster or slower than alternatives to driving and/or increased road capacity can be developed.

Gassing Up

3. a. If a person drives 10 miles to work in a car that gets the average 22 miles per gallon, 0.45 gallons of gas is consumed on the way to work.



b. If 30 people take a bus 10 miles to work and the bus gets 6.5 miles per gallon, 1.5 gallons are consumed by the whole bus, and 0.05 gallons per passenger.

c. The bus is the more energy efficient people-mover.

d. 74,898,000,000 gallons of gasoline are burned by the cars in the United States, combined, each year.

4. In the mid-1970s, the city of Portland, Oregon, found that it could reduce energy use by 5% simply by reviving neighborhood grocery stores. City officials found that people could take shorter car trips, or even walk to the nearby store in their neighborhood when they run out of something.

Human Masses, Greenhouse Gases

5. In the year 1900 the concentration of CO_2 in the air was between 260 and 280 parts of CO_2 per million. Now it is 350 ppm.

a. This is a 25-35% increase.

b. If you were writing an article to get people to be more cautious about burning fossil fuels, you would probably use the 35% figure.

c. If you were trying to play down the problem, you would use 25%.

6. If we wanted to reduce our CO_2 emissions so that we didn't add more to the atmosphere than it could absorb, scientists estimate we would have to limit ourselves to adding less than 9.8 billion tons each year.

a. Each person would be allowed to add 1.72 tons per year of CO_2 to the atmosphere if permits were allotted equally to all people.

b. 9.42 pounds per day.

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c. You could get 9.42 miles away by car on your allotted CO_2 emissions.

d. If Americans drive a total of 1.6 trillion (1,600,000,000,000) miles each year, they release 800 million tons of CO_2 each year.

7. If average fuel efficiency increases from about 20 mpg to about 40 mpg, but the number of miles driven by all the cars on the road doubles from 1.6 trillion to 3.2 trillion, we will not have changed our total CO_2 emissions at all.

8. 123,000,000,000 fast-growing young trees would be needed to absorb all the CO_2 in 6d.

9. Student answers will vary depending on their household's car activities or lack thereof.

10. Electricity use, water heaters, power lawn mowers, boats, motorcycles and stoves use fossil fuels and contribute to the greenhouse effect. Anything else that burns fossil fuels also adds CO_2 to the atmosphere.

Paving Parade

11. The *Statistical Abstract of the United States* estimates that there are 3,554,000 miles of paved public roads in the United States.

a) There are more people in the United States than miles of road.

b) The government spends $24,479 annually on each mile of road.

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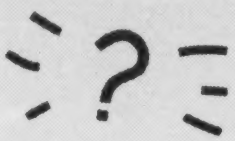
Discussion Questions:



1. Planting trees can help combat global warming, but the single best way for people to reduce their impact on the climate is to cut down on the amount of carbon dioxide they add to the atmosphere. This means reducing their use of fossil fuels. What are some specific ways that people can do this?

   Taking public transportation (e.g., buses, electrically powered trains, cable cars), making fewer unnecessary trips, carpooling, mixing exercise and transportation by cycling or walking to stores and work.

2. From 1975 to 1983 carbon monoxide, hydrocarbon, ozone and smog levels decreased in most U.S. cities because of some changes in cars and also because people moved away from cities to suburbs. These levels are on the rise again. Why do you suppose that is?

   There are more people and more vehicles on the road.

3. The standard fuel efficiency for a company's fleet of cars has been 26 miles per gallon (mpg) since 1985. Technologies are available that could bring mpg to 60.4. Look in the car advertisements in the newspaper and find some mpg figures. Which types of cars are more fuel efficient?

   Usually smaller, lighter, compact cars, which may be slower and less safe, have higher mpg's. Usually you find heavier, bigger and luxury cars as well as 4x4's to be gas guzzlers. A gas guzzler tax is applied to certain cars like Jaguars and Rolls Royces. The law mandates that the sticker price include note of a car's fuel efficiency.

4. What are the possible consequences of having more roads and parking lots?

   Less natural landscape, less arable land to grow crops, less grazing land for animals, less natural habitat for most species of wildlife, more pollution, etc. (Let students be creative with this.)

5. Ray Oldenburg, author of *The Great Good Place*, was told by a couple who had lived in Vienna, Austria, and Los Angeles, California, that "in Los Angeles we are hesitant to leave our sheltered home in order to visit friends or to participate in cultural or entertainment events because every such outing involves a major investment of time and nervous strain in driving long distances. In Vienna everything — opera, theater, shops and cafes — is within easy walking distance." Do you think car use in your neighborhood increases or decreases the sense of community? Why or why not?

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Follow-up Activities:

1. Have students explore particulate pollution in their neighborhoods by putting Vaseline on index cards and hanging them in various outdoor locations. After a week they can retrieve the cards and examine them with a magnifying glass to compare the pollution of busy intersections to that of quieter areas.

2. There are often local and national news articles on road expansions and other traffic issues that may be relevant. Have students express their views on these in a letter to a local government official. Be sure to have them include several persuasive arguments. Alternatively, you could invite a transportation department official to speak with the class.

3. Long-term Research Projects: As a class, brainstorm and create a list of all the possible things that could be done to improve transportation. Some of the alternative fuels being explored include ethanol, methanol and compressed natural gas, and each of these makes for a good science research project. Other approaches include promoting close-knit communities and telecommuting (to reduce the need for driving), bicycle use, carpools, mass transit and electric cars and adding gas guzzler taxes and increasing the fuel efficiency standards.

   Have the class come up with a list of criteria on which to evaluate or compare the ideas (e.g, pollution, road area, energy sources, capacity, convenience, resource conservation, cost, popularity).

4. Students might discuss ways to cut back the community's use of cars and then design a publicity campaign regarding an aspect of transportation and/or create relevant and artistic posters.

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Notes and Sources:

[1] *Commuting in America*, Eno Foundation for Transportation, 1987.
[2] *The Greenhouse Trap*, World Resources Institute, 1990.
[3] David Morris, Institute for Self Reliance, Speech at Twelfth International Pedestrian Conference in Boulder, CO, 1991.

Worksheet Question 1

U.S. Statistical Abstract 1995, #1023.
World Population Data Sheet 1993, Population Reference Bureau, 1993.

Worksheet Question 3

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David Morris, Institute for Self Reliance, Speech at Twelfth International Pedestrian Conference in Boulder, CO, 1991.

Human Masses, Greenhouse Gases Worksheet Introduction

Worldwatch Paper #98: *Alternatives to the Automobile: Transport for Livable Cities*, Worldwatch Institute, 1990.

Worksheet Question 5

Firor, John. *The Changing Atmosphere: A Global Challenge*, Yale University Press, New Haven, CT, 1990.

Worksheet Question 6

Stabilizing the Atmosphere: Population, Consumption and Greenhouse Gases, Population Action International, 1994.

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Worksheet Question 10

Car Trouble, World Resources Institute, 1993.

Discussion Question 3

Cogan, Douglas. *The Greenhouse Gambit: Business and Investment Responses to Climate Change*, Investor Responsibility Research Center, 1992.

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David Morris, Institute for Self Reliance, Speech at Twelfth International Pedestrian Conference in Boulder, CO, 1991.

Fun Facts

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TRANSPORTATION TALLY
Student Worksheet – Page 1 of 4

Driving to the Limit

1. In 1993 there were about 146 million automobiles registered in the United States, while the country's population was 258 million. How many people were there for each car in the United States in 1993?

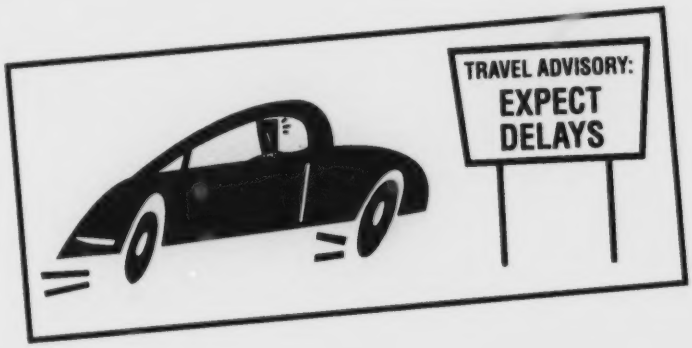
2. Los Angeles residents drive more than those in any other U.S. city. In the 1930s, car, oil and tire companies bought up the city's electric trolley lines, and took them out. Now visitors to the area notice how much people rely on cars there.

   a) Why do you suppose these companies did this?

   b) How much time would it take someone in the Los Angeles area to get to work if he/she were traveling 20 miles at 30 mph? (Use the formula: Time = Distance/Rate) _____hours. How many minutes is this? _____minutes.

   c) As more cars fill the freeways the average speed will drop. How much time would it take that same person to get to work if he/she could only travel at only 15 mph ? _____minutes.

   d) What is the difference in time between the two speeds? _____minutes.



   e) Do you expect congestion on Los Angeles roads to get better or worse in the coming decades? Why?

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Name: _____ Date: _____

TRANSPORTATION TALLY
Student Worksheet – Page 2 of 4

Gassing Up

3. As everyone knows, cars run on gasoline. In the United States the average car burns 513 gallons of gasoline each year. There are about 146 million cars on U.S. roads.

a) If a person drives 10 miles to work in a car that gets the average 22 miles per gallon, how much gas is consumed on the way to work?_____ gallons.

b) If 30 people take a bus 10 miles to work and the bus gets 6.5 miles per gallon, how much gas does the bus consume?____ gallons. What is each passenger's share of gas consumed?____ gallons.

c) Which is the more energy efficient people-mover? _____.

d) How many gallons of gasoline do all of the cars in the United States, combined, burn each year? _____ gallons.

4. In the mid-1970s, the city of Portland, Oregon, found that it could reduce energy use by 5% simply by reviving neighborhood grocery stores. Why might this be?

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TRANSPORTATION TALLY
Student Worksheet – Page 3 of 4

Human Masses, Greenhouse Gases

The "greenhouse effect" is caused by a layer of gases high above the Earth in the atmosphere. This layer traps the sun's warmth just like the glass roof of a greenhouse holds the warmth in for plants. Certain kinds of human activity create gases that add to this natural layer up in the sky. If we add too many "greenhouse gases" to the air, the planet may gradually get warmer and warmer. This may cause droughts and may melt polar ice caps, which would cause the sea level to rise and flood low areas of land. Or we may get more erratic weather in various places.

Carbon dioxide (CO_2) is one of these greenhouse gases. Scientists researching prehistoric levels of CO_2 find that although the levels go up and down somewhat with the seasons, making a zig-zag graph, the overall levels of CO_2 have risen sharply since the time of the Industrial Revolution. When gasoline, or anything else for that matter, is burned, CO_2 is released into the air. Nationwide, the production and use of automobiles account for about 30% of all the CO_2 created by using fossil fuels.

5. To describe how much of something is in the air, scientists use the expression "parts per million," or "ppm." Imagine a million purple dots and one orange dot. You could talk like a scientist and say "the concentration of orange dots in the area is one part per million." In the year 1900 the concentration of CO_2 in the air was between 260 and 280 parts of CO_2 per million. Now it is 350 ppm.

   a) What percent increase is this?_____ (Note: This will be a range.)

   b) If you were writing an article to get people to be more cautious about burning fossil fuels, which figure would you use? _____

   c) If you were trying to play down the problem, which number would you use? _____

6. If we wanted to reduce our CO_2 emissions so that we didn't add more to the atmosphere than it could absorb, scientists estimate we would have to limit ourselves to adding less than 9.8 billion tons each year.

   a) How many tons of CO_2 would each person be allowed to add to the atmosphere if permits were allotted equally to all people? (Use the 1996 world population figure of 5.7 billion people.)
   _____

   b) How many pounds per day? (1 ton = 2,000 pounds) _____

   c) Driving one mile releases approximately one pound of CO_2 into the air, on the average. How far could you get on your allotted CO_2 emissions by car? _____

   d) If Americans drive a total of 1.6 trillion (1,600,000,000,000) miles each year, how many tons of CO_2 do cars release each year?_____tons.

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TRANSPORTATION TALLY
Student Worksheet – Page 4 of 4

7. If average fuel efficiency increases from about 20 mpg to about 40 mpg, but the number of miles driven by all the cars on the road doubles from 1.6 trillion to 3.2 trillion, how much will we have changed our total CO_2 emissions? _____

8. Trees and other plants use carbon dioxide as they grow, and they produce oxygen that people breathe. In an industrial society, where more and more fossil fuels are burned each year, trees are vital to the health of our planet. One fast-growing young tree absorbs 13 pounds of carbon dioxide each year. How many of these trees would be needed to absorb all the CO_2 in 6d? (Round to the nearest billion.)_____ trees.

9. Determine to the best of your abilities how much carbon dioxide your household's car activities add to the atmosphere in a year: Find out how many miles the family drove in the past year and how many miles per gallon of gasoline the family car gets. (If there is more than one car, get these figures for each car.) Divide the miles driven by the miles per gallon to calculate how many gallons of gasoline the family car(s) burned during the year. Each gallon burned produces about 20 pounds of CO_2. Show your work. _____

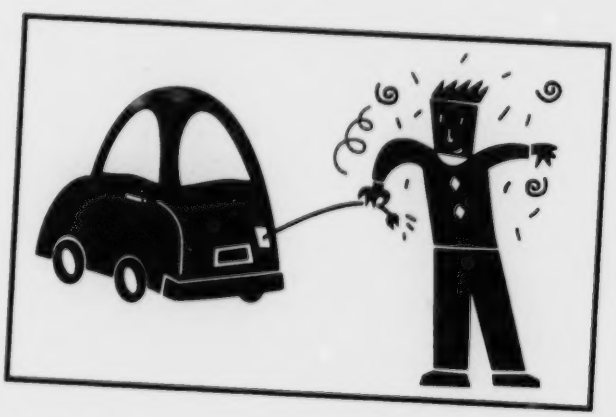
10. Only 30% of the CO_2 that is released from burning fossil fuels comes from automobiles. What other kinds of human activity contribute to the greenhouse effect?

Paving Parade

11. The *Statistical Abstract of the United States* estimates that there are 3,554,000 miles of paved public roads in the United States.

    a) Are there more miles of road or more people in the United States?

    b) If the government spends $87,000,000,000 on roads per year, how much does each mile of road cost per year?



FUN FACTS!

- Electric cars do not have polluting tailpipes. If, by the year 2010, there are 14 million electric cars in the United States, about 1/2 million barrels of oil per day would be conserved by the year 2010.
- You can say that bicycles get 1,500 miles per gallon if you were to convert all the food energy that the cyclist eats to oil.

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ACTIVITY 16

If Money Won't Buy It...

Concepts:
Modern economics do not distinguish between renewable and nonrenewable resources. All materials are quantified by a price that often does not account for the environmental cost to society.

Objectives:
Students will be able to:
▶ Determine how their consumer choices would be affected if a natural resource rationing system were imposed.
▶ Express their values as they make lifestyle decisions based on a rationing system.
▶ Calculate the environmental cost of everyday actions.

Subjects:
Math, Science, Social Studies

Skills:
Adding, subtracting, interpreting data, problem solving, decision making, critical thinking

Method:
As an exercise in critical thinking, students evaluate the environmental impact of their lifestyles.

Introduction:

How would we react if the government issued a new charge card to every individual,.corporation and institution that had the effect of limiting our purchasing power? The charge card would represent the number of "natural resource units" (NRUs) that each of us, regardless of income, would be allowed to spend each year. The card would be used along with our monetary system and would be presented when purchasing items or services. A number of NRUs, corresponding to the environmental impact of the purchase, would be deducted from our annual allowance.

Materials:

Student Worksheet (one per student)
Rating Sheet (one per student)

Procedure:

1. To set the stage for this activity, tell students that they will be using the class period to spend a new kind of money. Describe the natural resource units system and distribute a Student Worksheet and a Rating Sheet to each student. Students should consider the items on the sheet and decide how they would spend their natural resource units during a one-year period. The cost of each item in NRUs has been determined by considering the following impacts (see Rating Sheet):

   - use of energy or resources
   - disturbance of natural area
   - pollution of air, water or land
   - temporary disturbance (such as noise pollution)

2. Go over the ratings on pages 97-98. Discuss with your students that they will be limited to 30 NRUs and that they must determine their choices accordingly. Remind them that this is only a simulation, for the environmental impact listed accounts for the impact of use and not for the impact of production. The energy use of appliances shows the average number of kilowatt-hours (KWH) used per month as determined by the Lawrence Berkeley Laboratory.

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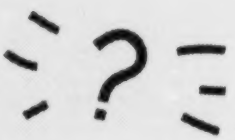
The following figures are from *The Consumer Guide to Home Energy Savings*, published by the American Council for an Energy-Efficient Economy, Washington, DC, 1993. One KWH is the equivalent of a 100-watt light bulb turned on for ten hours.

Household product	Number in use (millions) in the U.S.	KWH/month
clock	160	2
VCR	59	3
coffee maker	6	4
toaster	86	4
electric blanket	27	10
computer	13	11
color TV	87	21
spa/hot tub	2	192

3. Introduce students to the following facts on the energy use of home appliances and the fuel consumption of various vehicles.The use of gasoline to fuel cars, buses and planes also has a large environmental impact. Consider the average passenger-miles per gallon: 27 for air travel, 31 for an urban bus, 37 for a subway and 110 for an intercity bus. Pollution of air, water and land is either an indirect or direct effect of using these items. Motor vehicles add to air pollution and in some instances water pollution. The electricity required to run appliances results in air pollution at the electrical generating plant where fossil fuels are burned or can result in toxic waste at the nuclear power plant. If students disagree with any of the ratings, change them according to class consensus. If they would like to add other items to the purchasing list, have the class determine the cost of additions in NRUs.

Discussion Questions:



When NRUs have been spent, go over the sheet and ask for a show of hands to indicate how many people selected each item.

1. Which actions or purchases were most popular?

2. What trade-offs did students make to stay within the limits of 30 NRUs?

3. Do the students think such trade-offs would be worth the benefit of a healthier, cleaner environment?

4. How would the students react if such a plan were initiated by the government?

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Follow-up Activities:

1. Students can make a list of material goods and recreational activities they consider desirable. They can then use the criteria on the rating sheet to assign NRUs to each product and activity. In a follow-up discussion, ask the students to describe whether or not these ratings have any effect on their desires to purchase products or participate in activities. What products or activities are most costly in terms of NRUs?

2. Students can continue the discussion with their friends and families in order to investigate the environmental impact of their community's choices. Studying their lifestyles as well as the lifestyles of those close to them can lead students to realize the importance of their decisions in maintaining a healthy environment. Ask students to compare lifestyles now with lifestyles in the past. Have their communities reduced water use or introduced the regulation of car emissions? Have steps been taken to account for environmental costs in society?

3. Research ways in which the students can become environmentally wise consumers by reading through books such as the *Consumer Guide to Home Energy Savings: Listings of the Most Efficient Products You Can Buy ... and Much More* by Alex Wilson. Available from the publisher, the American Council for an Energy-Efficient Economy, 1001 Connecticut Avenue, NW, Suite 535, Washington, DC 20036.

Sources:

Gershorn, David and Gilman, Robert, *Household Eco Team Workbook*, Global Action Plan for the Earth, 1990, pp. 49, 61, 79.

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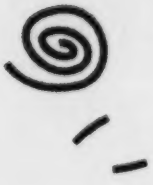

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IF MONEY WON'T BUY IT
Student Worksheet – Page 1 of 2

You have 30 natural resource units (NRUs) to spend during the next year. These NRUs account for the environmental impact of use, not production. If you had graduated from school and were just beginning to set up your new home, how would you spend your NRUs?

Consider the following facts:

- Some of the biggest energy-using appliances are hot tubs, aquariums, refrigerators, clothes dryers, color TVs and stoves.
- Most of us enjoy air conditioning on those hot summer days — the air conditioner (window unit) uses about 6 times more energy than a color television in one month.
- Each day, 146 million cars clog the highways and roads of America.
- Bicycling and walking are healthy means of transportation that do not use natural resources and do not pollute the atmosphere.
- Every full bus removes 40 single passenger cars from traffic.
- Traveling by train uses 75-80% less energy per passenger mile than flying and 30-50% less energy than driving.

Action/Purchase			Cost in NRUs
Recreation	Vacations:	Take a bus to spot of your choice up to 1,000 miles away	8_____
		Take a plane to spot of your choice up to 1,000 miles away	14_____
		Drive own car to spot of your choice up to 1,000 miles away	10_____
	Use of:	bicycle	2_____
		cross-country skis	1_____
		rollerblades	1_____
		motor boat	11_____
		sailboat	1_____

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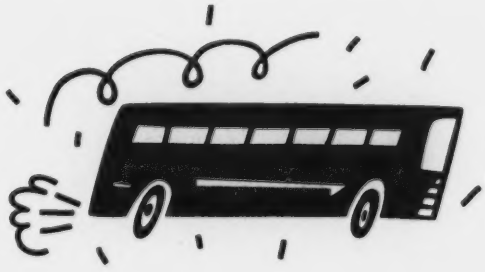
IF MONEY WON'T BUY IT
Student Worksheet – Page 2 of 2

Action/Purchase		Cost in NRUs
Home	clock	2.0_____
	VCR	2.0_____
	coffee maker	2.5_____
	toaster	2.5_____
	electric blanket	3.0_____
	computer	3.0_____
	color TV	4.5_____
	air conditioner	8.0_____
Transportation	large luxury car (15 miles per gallon)	13.0_____
	small economy car (40 miles per gallon)	9.0_____
	use of mass transportation	6.0_____
Other	Determine other items you would like and use the categories on the next page to figure the cost in NRUs.	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____



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RATING SHEET

ENVIRONMENTAL IMPACT IN NRUs

Natural resource units (NRUs) are assigned in each category on a scale of 0 to 4. These numbers show the environmental impact of each item:

0 = no impact 1 = very little 2 = some impact 3 = quite a bit 4 = heavy impact

Action/Purchase	Impact in NRUs				
	Uses energy or resources	Disturbs natural areas	Pollutes air, land or water	Temporary disturbance (e.g., noise)	TOTAL
Recreation					
bus travel	2	3	2	1	8
plane travel	4	3	4	3	14
car travel	3	3	3	1	10
bicycle	0	2	0	0	2
cross country skis	0	1	0	0	1
rollerblades	0	1	0	0	1
motor boat	3	2	2	4	11
sailboat	0	1	0	0	1
Home					
clock	1	0	1	0	2
VCR	1	0	1	0	2
coffee maker	1.5	0	1	0	2.5
toaster	1.5	0	1	0	2.5
electric blanket	2	0	1	0	3
computer	2	0	1	0	3
color TV	5	0	1	1	4.5
air conditioner	5	0	1	1	4.5
Transportation					
large car	4	3	4	2	13
small car	2	3	2	2	9
mass transit	1	2	1	2	6
Other					

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ACTIVITY 17

Treasures Underground

Concepts:
Minerals are finite, nonrenewable resources we depend on for many products in our daily lives. Conservation of minerals is critical so that we have enough to last for the future and so that we do not destroy precious land for mining operations.

Objectives:
Students will be able to:
▶ Appreciate how many items come from materials mined from the Earth.
▶ Understand how mining operations can affect the land.

Subjects:
Science, Social Studies, Math

Skills:
Drawing connections, using fine motor skills, brainstorming

Method:
Students investigate the mineral content of everyday items and simulate mining activities in this two-part exercise.

Introduction:

Nonrenewable resources are those that can never be replaced once they are used up. Our Earth is rich with minerals that we depend on to produce many of the products we use every day, from the building materials of our homes, cars and appliances to our food containers, tires, cleansers and art supplies. Some minerals are very common and others are very scarce. As the human population grows, the demand for minerals grows as well. Mining for minerals takes place all over the world. Digging minerals from the ground often damages the land.

Materials:

Part 1:

Student Worksheet (one per student)

Part 2:

Hard chocolate chip cookies (one per student)
Toothpicks
Napkins

Part 1: Mineral Match-Up

Procedure:

Here's a way to get students thinking about how we depend on minerals.

1. Copy the Student Worksheet and give one to each student. The worksheet asks students to match up some common household items with the minerals from which they were made. After students have completed the worksheet, go over the answers as a class.

2. Ask students to name some items that they enjoy using. This might include a television, computer games, CDs, certain toys and appliances. After listing their suggestions on the board, have the students brainstorm as a class what elements from the ground may have been used to produce each item. For instance, electronic equipment may have a plastic shell (a petroleum product) and copper wiring. Some of the elements may be obvious; students may have to look up others in the encyclopedia. You could extend this as a library activity for finding out some of the answers.

Student Worksheet Answers:
1.E, 2.L, 3.M, 4.P, 5.D, 6.N, 7.A, 8.B, 9.O, 10.K, 11.C, 12.H, 13.F, 14.Q, 15.J, 16.G, 17.I

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Part 2: Mining for Chocolate

Procedure:

1. Distribute the cookies to the students (but they mustn't eat them!). Tell them that the cookies represent the land and the chocolate chips represent minerals, like coal, that they will be mining from the cookie. Ask students to estimate how many chips are in their cookies.

2. With their toothpicks, students will attempt to extract the chips from the cookies, trying to do as little damage to the cookies as possible. Cookies should stay flat on a napkin or plate, as hills cannot be picked up. After a few minutes of mining, ask students if they wish to change their estimate of how many chips are in their cookies.

3. After students have completed the activity, ask them to share the difficulties they had with their mining operations with the class. Ask them to predict whether mining companies might have the same kinds of difficulties.

4. Have students brainstorm ways to reclaim their land (the cookies). Can the cookies be put back together? (Remind students that most of the soil and rocks left after a mining operation are unable to grow plants.)

5. Eat the cookies!

Follow-up Activity:

Because minerals are nonrenewable resources, they need to be conserved and recycled so that we don't run out of minerals that are in shorter supply. Select several of the minerals listed on the Student Worksheet and ask students to offer suggestions on how these elements might be conserved. For instance, tin and aluminum cans are often recycled as part of curbside recycling programs. Tin cans can be washed and reused as containers for pennies or paper clips. Gold can be melted down and redesigned for other uses. Aluminum cans can be remade, saving 95% of the energy used to make new cans from newly mined aluminum.

Part 2 adapted with permission from *OUTLOOK, Environmental Education Enrichment*, published jointly by the Iowa Natural Heritage Foundation, the Iowa Department of Education and the University of Northern Iowa. Direct inquiries to David V. McCalley at the Institute for Environmental Education, McCollum Science Hall, University of Northern Iowa, Cedar Falls, IA 50614-0421.

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TREASURES UNDERGROUND
Student Worksheet

All of the items listed below are made of minerals mined from the ground. In the blank to the left of the items listed, write the letter of the element from which these items were made. The elements are listed at the bottom of the page.

1._____Soup cans
2._____Matches, gunpowder, rubber
3._____Watches, radios, televisions, radar instruments
4._____Pencils
5._____Bricks, pottery, tennis courts
6._____Pennies, stereo wire, brass instruments
7._____Wedding band, first-place medal, nuggets
8._____Soda pop cans, foil wrap, baseball bats, house siding
9._____Horseshoe, hammer, steel products (cars, eating utensils, swords)
10._____Food seasoning and preserver
11._____Plastics, heating fuel, gasoline, vinyl, synthetic fabrics
12._____Old five-cent coins, paper clips
13._____Baby powder, crayons, soap
14._____Jewelry, drill bits
15._____Charcoal, tar
16._____Pipes, old paint, X-ray shields
17._____Flatware (forks, knives, spoons), jewelry, second-place medal

A. Gold
B. Aluminum
C. Oil (Petroleum)
D. Clay
E. Tin
F. Talc
G. Lead
H. Nickel
I. Silver
J. Coal
K. Salt
L. Sulfur
M. Quartz
N. Copper
O. Iron
P. Graphite
Q. Diamonds

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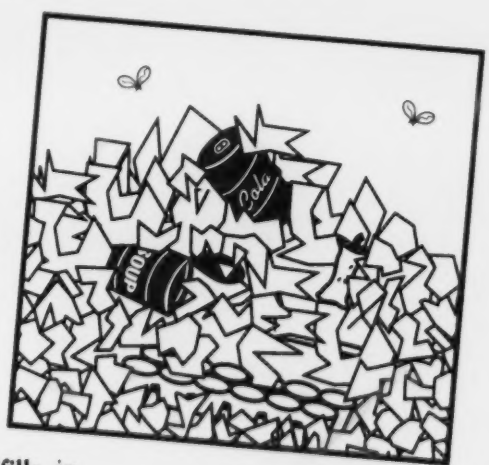
ACTIVITY 18

Stash The Trash

Introduction:

Today's methods of solid waste disposal are inadequate to handle the volume and variety of trash we're already generating. An increase in the amount of garbage we produce in the future is likely to be equal to the growth in our population. At our current rate of growth, the United States' population is expected to double in about 89 years. If we are overwhelmed by the mass of trash yielded by our population now, how can we expect to deal well with twice as much?

We generate all kinds of solid waste: paper, aluminum cans, glass jars, plastic bottles, spoiled food, broken TV sets, old stoves, junk cars and other garbage that people throw away. In the United States, each of us generates an average of 3½ pounds of it per day — that adds up to more than 168 million tons every year! Each type of solid "waste" is composed of one or more types of matter that started out as a raw materials taken from nature. They reach us in the form of plastic bottles, juice boxes, cardboard cartons and so on only after going through a *long* series of processes. When we throw these things away after one use, we waste not only the physical thing itself, but all the effort, energy and other resources that went into creating it. All that trash has to go somewhere; what should we do with all of it?



When we toss it away carelessly, it litters streets, highways, the countryside and waterways; burning it in the open pollutes the air; and when we leave it in the open at garbage dumps, it smells, looks ugly, and attracts rats and insects. If we bury it, we lose the value of materials in it that might be *recycled* (reused).

Most of our solid waste goes to open garbage dumps. These improve considerably when they are turned into **sanitary landfills**, in which a layer of soil is applied daily over the waste. This keeps pests away and makes burning the waste unnecessary. The soil layer also prevents trash from being washed or blown off the site by rain or wind.

A more accurate name for most of these materials would be "wast*ed* solids," because it is not the materials themselves that are wasteful, but the way we treat them. Actually, they are valuable resources, which, if used appropriately, could save us a huge amount of time, effort and energy. Why not refill an empty container or reshape the already-processed material it's made of into a new object, rather than starting from scratch again and again?

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Concepts:
Population growth and resource consumption create more and more solid waste that never really goes "away."

Objectives:
Students will be able to:
▶ Construct a mini-landfill in a jar.
▶ Observe and record the extent to which materials decompose in their mini-landfills.
▶ Calculate the amount of garbage generated by each person in a year.
▶ List ways to reduce solid waste production.

Subjects:
Science, Math

Skills:
Collecting and analyzing data, understanding cause and effect, brainstorming, calculating, observing, preparing a lab

Method:
Students construct a miniature sanitary landfill and identify the advantages and disadvantages of disposing of solid waste by this method.

There are some wastes we haven't figured out how to recycle yet, such as certain plastics. It may seem easier and cheaper just to throw away even those things we do know how to recycle. But hauling, dumping and replacing the items we throw away is expensive. While the hauling and sorting involved in recycling may not be much cheaper than trash collection in terms of the public money spent, it does spare other resources that are of value to us all. For example, if all recyclable items were separated from non-reusable, biodegradable materials, the volume of garbage would be much smaller, and so would the amount of landfill space required to accommodate it. This would make more land available for parks, farms, wildlife habitat and other uses. It would also save the environment the stress caused by our constantly extracting more raw materials from it through mining, logging and other methods.

The best way to ease the problem of disposing of solid waste is to produce less of it. Do we really need all the cellophane, cardboard, colored paper, metal foil and plastic bags in which so many things come wrapped?

Materials:

(For each group of students)
A large container, such as a glass jar or milk carton
Soil
A piece of fruit or vegetable, such as a slice of tomato or an apple core
A small piece of plastic, such as a plastic fork or part of a broken toy
A piece of newspaper or letter-quality paper
Optional: Pieces of fabric, styrofoam, aluminum foil, glass; grass or shrubbery clippings; chewing gum; cigarette butt; other items students select
Student Worksheet (one per student)

Procedure:

1. Present the information in the Introduction above to the class, allowing discussion and answering any preliminary questions that students may have.

2. Duplicate the Student Worksheet and give each student a copy.

3. Divide students into small groups. Provide the materials listed above to each group, or have each group's members divide among themselves the responsibility for bringing in items needed by their group. (Many of these items may be available from the school cafeteria.)

4. Instruct students to list materials they will be burying in their miniature sanitary landfills and estimate the extent to which they expect each one will decompose in one week, one month, three months and six months. Each group should then construct a miniature sanitary landfill, following the instructions on the Student Worksheet. (Alternatively, one miniature landfill may be constructed by the class as a whole.) Instruct students to keep the soil damp in the weeks and months that follow.

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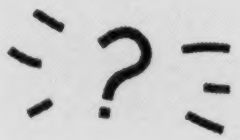
5. One week, one month, three months and six months after the miniature sanitary landfill(s) are constructed, have students observe the extent to which the items "disposed of" in their landfill(s) have changed or decomposed. Students should assess the accuracy of their initial estimates about how much each item would decompose over the different periods of time.

6. Pose the discussion questions below to the class. Allow them to brainstorm as much as possible before providing any of the suggested answers.

Discussion Questions:



1. Which do you think is more harmful to the environment, a material that decomposes rapidly or one that lasts a long time without decomposing? Why?

   A material that decomposes quickly is less damaging to the environment than one that lasts a long time without decomposing. When materials decompose, they become a part of the soil, returning nutrients to it that enrich it. At best, materials that don't decompose just occupy space that therefore can't be inhabited by plants, animals or people. At worst, they actually interfere with natural systems, thereby causing harm to living creatures.

2. If each American produces about 3½ pounds of solid waste per day, how many pounds does one person produce in a year?

   1,277½ pounds.

3. How much garbage do you think your family generates each day? Each year?

4. If each family in the United States could only throw away 5,000 pounds of trash per year, how much would each member of your family be able to throw away each year?

5. The U.S. population grows by 2,600,000 people a year, so about how many more pounds of garbage does the United States have to dispose of each year?

   About 3,321,500,000 pounds more each year.

6. How many tons of garbage is this? (Hint: 1 ton = 2,000 lbs.)

   That's 1,660,750 tons more per year.

7. What habits could we adopt to solve, or at least lessen, the solid waste problem in the United States?

   Possible answers include:
   1) When shopping, choose items with as little packaging as possible. (About 1/3 of all trash is packaging!)
   2) Recycle glass, aluminum, newsprint, office paper, cardboard and certain kinds of plastic through local programs.

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3) *Make recycling a growth industry by buying products that are recycled, recyclable, refillable, reliable, repairable and/or reusable.*
4) *Choose reusable items over throwaways wherever possible: mugs and glasses instead of styrofoam or paper cups; dishtowels, rags or sponges rather than paper towels; rechargeable rather than single-use batteries; and so forth.*
5) *Donate used clothing, books, appliances, etc., to local thrift shops or shelters, rather than putting them in the trash.*
6) *Avoid plastic whenever possible; it doesn't biodegrade! Keep a clean fork, knife and spoon with you (in your purse or bookbag) so you won't pick up and throw away plastic ones when you stop for a snack; don't use plastic lids and straws with beverages; choose paper, glass or metal over plastic packaging for all sorts of products, such as soda, chips, peanut butter, milk, etc.; bring your own bags from home or ask for paper ones at the supermarket; reuse supermarket bags in trash cans at home instead of buying specially made plastic ones.*
7) *Make a compost pile in your backyard — the decomposed material makes a great plant fertilizer. Organize a compost program in your neighborhood.*
8) *Avoid clothing that's made from synthetic fibers such as polyester (they don't biodegrade easily) or that requires dry cleaning (dry-cleaners wrap clothes in lots of plastic after cleaning them).*
9) *Have a small family: more people consume more stuff and generate more waste in the process.*

Guess how long the following items would each last in a landfill?
Banana peels? (*Answer*: 2 years)
Plastic bags? (*Answer*: 10-20 years)
Plastic bottles? (*Answer*: 100 years)
Aluminum cans? (*Answer*: 500 years)
Glass bottles? (*Answer*: 1,000 years)
Styrofoam? (*Answer*: 10,000 years)

Follow-up Activities:

1. Find out about the solid waste management system in your local area. How is the trash disposed of? Is the existing system designed to handle the amount of solid waste the population is likely to generate over the next five years?

2. Take a class field trip to a real sanitary landfill. (The sight and smell of a huge landscape full of garbage is an impressive and unforgettable experience, which will go a long way toward reinforcing the ideas introduced by this activity.)

The *Stash the Trash* miniature sanitary landfill activity and introduction on the student worksheet were adapted from *Earth Trek ... Explore Your Environment*, U.S. Environmental Protection Agency, Washington, DC 20460, April 1987.

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Name: _____ Date: _____

STASH THE TRASH
Student Worksheet

1. Assemble the items to be "disposed of" in the miniature sanitary landfill. You will construct and list them in your lab notebook.

2. Place some soil in the bottom of the container. On top of the soil, place the fruit, plastic, paper and other items. Add more soil on top of them. Put the container in a warm place, and keep the soil damp.

3. Estimate the extent to which each item will decompose in one week, one month, three months and six months, and record your estimates next to the items on your list. Some of these items will decompose (break down) and become part of the environment, while others will last a long time.

4. After one week, check to see what has happened to the items you buried in the soil. Which things look different than they did when you buried them? Record the changes you see in your lab notebook. How accurate were your estimates about the extent to which the items would decompose?

5. Check the materials again one month, three months and six months from the date you created the miniature landfill, and again note your observations in your lab notebook. How accurate were your estimates about decomposition over these time periods?

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ACTIVITY 19

Market Research

Concepts:
Each of us can reduce the amount of waste we generate by "precycling," or selecting products with minimal amounts of packaging.

Objectives:
Students will be able to:
▶ Compare different sizes and containers of the same product to determine which produce the least amount of solid waste and save the most money.
▶ Identify at least three ways shoppers can make choices that help conserve natural resources.

Subjects:
Science, Math, Social Studies

Skills:
Collecting and interpreting data, understanding cause and effect, researching

Method:
Students visit the supermarket after an introduction to the principles of supply and demand. There they determine how these principles can be put to use in making environmentally sound decisions in the everyday activity of grocery shopping.

Introduction:

We usually choose grocery items based on their taste, usefulness and cost. But the amount of waste that will be left when we're finished with the product is also an important consideration. We should ask: Was this product packaged as efficiently as possible? Was the manufacturer careful to use no more material than necessary? Did the manufacturer use recycled and recyclable materials wherever possible? By making our selections according to the answers to such questions, we can encourage fuel-efficiency, clean (non-polluting) production and minimal generation of solid waste in the everyday act of grocery shopping.

Materials:

Paper and pen or pencil
Calculator (optional)
Student Worksheet (one per student)

Procedure:

Take a class field trip to the supermarket or assign the activities on the Student Worksheet as homework. In either case, students should work in small groups, with one activity assigned to each. When the activities are completed, each group will report their conclusions to the rest of the class, followed by discussion.

Discussion Question:

What are some specific choices individual shoppers can make to help conserve resources and protect the environment?

Possible answers:

1) Ask the cashier not to put your purchases in a bag at all if it's not necessary. If you're only buying one or two items you can easily carry them, or if you have a bookbag or purse with you, they might fit in there.
2) Request paper bags rather than plastic ones, or bring your own bags to avoid using new ones.
3) Buy items with as little packaging as possible. Choose paper packaging over plastic, if facilities for recycling the type of plastic used aren't part of your community's recycling system.
4) Buy reusable products rather than disposable ones.
5) Reuse or recycle packaging items as much as possible. For example, you could use plastic grocery bags to line garbage cans around the house instead of paying for specially made garbage bags.
6) If you drive to the supermarket, plan your trips before you go and make a list of what you'll need for the week. That way you'll be sure to get everything you need on the first try, rather than driving to the supermarket more frequently to pick up the things you forgot the first time.

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Follow-up Activity:

Have students call or write to one or more beverage packaging companies, and ask them the following questions about different beverage packaging formats (e.g., cans, no-return bottles, returnable bottles). Consider not only the type of container, (e.g., bottle or can) but also the materials used to make it (glass, plastic, aluminum, other metals).

- Which format for packaging beverages uses the least amount of raw materials?
- Which format uses the least water in processing?
- Which format produces the least amount of water pollution?
- Which format produces the least amount of air pollution?

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MARKET RESEARCH
Student Worksheet – Page 1 of 2

Group 1 - Pop Shop

In the beverage section of the supermarket, compare various packagings of the same soda pop (that is, cans vs. no-return bottles vs. returnable bottles, as well as containers of different volumes).

1. Which one is the "best buy"? State the cost of each, per unit of volume, to support your conclusion.

2. Which one produces the least amount of after-use solid waste to dispose of? What are the best options for disposal or recycling of each type of packaging, in the interest of environmental protection and resource conservation?

Group 2 - Package Baggage

In the supermarket, find one kind of non-beverage product that is packaged in different ways. Compare the different packaging formats:

1. Which one is the "best buy"? State the cost of each, per unit of volume, to support your conclusion.

2. Which one produces the least amount of after-use solid waste to dispose of? What are the best options for disposal or recycling of each type of packaging, in the interest of environmental protection and resource conservation?

Group 3 - Bag Drag

1. Watch people who are leaving the supermarket. What proportion of people leave the supermarket with two or more bags? For what proportion of shoppers would a bag not be necessary?

2. Ask the store manager what bags cost the store. Where does the money to pay for them come from?

3. Does the store offer both paper and plastic bags? If not, why not? If so, what proportion of shoppers choose each type of bag?

4. How do you "get rid of" a bag once it has been used? Where does it go? What happens to it next? Which type of shopping bag — paper or plastic — can be created and disposed of or recycled with the least harm to the environment?

5. How could paper shopping bags be reused? Plastic ones? Can you think of a way a person could cut down on the use of disposable shopping bags? How could you avoid using them altogether?

6. Does the supermarket collect used bags from shoppers for reuse or recycling? Does the supermarket offer a bonus or discount to shoppers who bring their own bags?

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MARKET RESEARCH
Student Worksheet – Page 2 of 2

Group 4 - Size Wise

1. Randomly select 8 products in the supermarket and check prices per unit of products across several different sizes of packages (same brand). Are larger or smaller packages generally the better buy? Why do you think this is the case? Are they always the better buy?

2. If the supermarket sells some items in bulk, select two of those items. Compare the cost per unit of weight with the cost of the same item pre-packaged in the largest quantity available. (If more than one brand is sold pre-packaged, note the cost of two or three different brands per unit of weight.) Which is the best buy? Why? Which produces the least amount of after-use waste to dispose of?

Group 5 - Disposer Posers

Find at least three items sold in the supermarket that are designed to be disposed of after only one or a few uses.

1. To what extent is each item essential? Can you think of a non-disposable item a person could use instead of each disposable one?

2. Can any of the items you selected be refilled or otherwise reused many times?

3. How is each item disposed of? What happens to it then?

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ACTIVITY 20

Waste Not, Want Not

Concepts:
Reusing items reduces solid waste by decreasing the volume of discarded items as well as the demand for new items to be manufactured.

Objectives:
Students will be able to:
- ▶ Brainstorm ways to reuse items instead of throwing them away.
- ▶ Plan a schoolwide event to encourage others to reuse items, where possible, in creative ways.

Subjects:
Science, Language Arts, Social Studies

Skills:
Critical thinking, brainstorming, creative writing

Method:
Students find ways to reuse household items in an activity that turns trash into school supplies and in planning a no-waste party.

Introduction:

This activity includes three parts: (1) a creativity exercise to identify ways commonly discarded household items might be productively reused; (2) a schoolwide event that promotes reuse of household waste while providing teachers and students with needed supplies; and (3) a no-waste party. This sequence works well, as the class does the "Creative Reuser" part while they are gathering the materials needed for the schoolwide reusing event. When the event is over, they can celebrate with the no-waste party.

Procedures:

Part 1: From Trash to School Supplies

Many household items routinely discarded in students' homes could be used by teachers and other students seeking low-cost supplies for classroom activities and school projects — or could be donated to area elementary or nursery schools, or even day care centers. Here is an event students can plan and carry out to both demonstrate the ease and desirability of reusing, and provide teachers and students with supplies they need.

1. Go over the introductory information in "*Stash the Trash*" (Activity 18) to reinforce to students the importance of reducing the amount of items we throw away.

2. As a class, adapt the sample flyer for your event. Are there any other "throwaway" items teachers or students could use if they were made available in quantity? Brainstorm on possible additions to the list of items on the flyer. Solicit suggestions from other students and teachers.

3. Ask students to begin saving items on this list that would otherwise be thrown away in their homes, and to enlist the help of all family members. Provide large collection bins in the classroom. Students should persist in encouraging the entire student body and faculty to contribute, reminding them of how items from the list can be used for their various projects.

4. On the day of the event, be sure that all bins are clearly labeled and that reused shopping bags or boxes are provided for items taken by participants. Students should be prepared to help participants find what they need. Refreshments (served using non-disposable supplies, if possible) may provide a further enticement to participate.

Part 2: The Creative Reuser

Select one item from the list on the flyer and have students (individually, in small groups, or as a whole class) brainstorm on possible ways the item can be reused. Creativity should be strongly encouraged; no suggestion is too

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absurd to be included! After the session is finished, the class can go back over the list and eliminate suggestions that seem impractical. If you prefer, assign this as a creative writing project (e.g., "My Memorable Year as a Yogurt Container"). Students might also create illustrations of some of their suggestions to display at the reusing event. Such suggestions, stories and illustrations might inspire teachers and other students to consider new ways they might use these "throwaway" materials.

Part 3: A No-Waste Party

Have the class plan a party or picnic that produces little or no waste. Challenge students to plan the event to use non-disposable or recyclable items for everything from decorations to refreshment supplies. Be sure the class takes responsibility for actually reusing, recycling or composting any items that might otherwise become waste. This activity reinforces two ideas: (1) that things thrown "away" don't actually go away but do go somewhere, and (2) that students can exercise choice about the way they use resources.

Follow-up Activity:

Have students plan and carry out a Community Information Night to present to parents and others in the community what the class has been doing to reduce waste. It may be billed as an evening of community involvement, where refreshments are served and everyone has an opportunity to learn how he/she can contribute to a cleaner community. Students may display and describe their class projects and perhaps present (and/or hand out) a list of ways everyone can help reduce solid waste and protect the environment.

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Sample Flyer

One Person's Trash Is Another Person's Treasure!

Teachers, students: Come one, come all — to the recycling event of the year!

Creative Recycling Night

October 18, 1997: 6-8 p.m. Lincoln Middle School Cafeteria

- **Collect valuable supplies for your school projects from our bins stocked with goodies rescued from the trash cans of students' and teachers' homes.**
- **Student environmental education projects will be displayed, refreshments will be served, and everyone will receive a list of ways that he/she can help solve our community's trash disposal problems.**
- **Come for entertainment, involvement and great supplies!**

We will have bins full of the following items, all clean and ready to be used again for your school projects:

juice cans and their lids
plastic yogurt containers/lids
margarine tubs (and other plastic containers) and lids
coffee cans and lids
baby food jars and lids
35mm film canisters and lids
toilet paper rolls
paper towel rolls
egg cartons
tops of plastic milk bottles
paper bags - all sizes
plastic shopping bags
coffee scoops
6 oz. cat food/tuna cans
plastic lids
milk cartons
shoe boxes
small boxes with covers
magazines and catalogs with colorful pictures
popsicle sticks
newsprint
rubber bands
wood scraps
wallpaper scraps
fabric scraps
buttons
socks (unmatched okay)
mittens (unmatched okay)
plastic forks, knives, spoons
ribbon, yarn, string
unused stickers and stamps
crayons (broken okay)
corks
bottle caps
hangers
shirts that button down the front
styrofoam packing materials
rug scraps
cardboard
oatmeal boxes
clay or plastic flowerpots
aluminum pie plates
plastic trays from microwavable prepared foods
aluminum trays from frozen dinners

Please be sure all items are clean. Pack items of the same kind together in a bag and write the contents on the outside of the bag. This will be a big help as we sort and store our supplies.

THANK YOU!

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ACTIVITY 21

Eco-Ethics

Introduction:

This activity is designed to give students the opportunity to examine their own values and beliefs as they relate to the environment, population and social issues, while gaining an understanding of the complex issues in many of today's environmental debates. It is not the intent of this activity to prescribe "right" and "wrong" answers for the students. In some cases, students may perceive what would be the most ethical solution to a given problem, while admitting that they realistically might not choose that option. On each Dilemma Card, the action choices are preceded by "would you" rather than "should you." This will encourage students to offer what they probably would do in each given situation. It might be useful to compare students' reactions to each dilemma both before and after going through the student readings and lessons.

Materials:

Copies of Dilemma Cards (provided)

Procedure:

1. Copy and cut the Dilemma Cards so that there are enough cards for each student to get one.

2. Divide the class into groups of four, and give each student a Dilemma Card.

3. Have students draw cards, study the situations, decide what he/she would do, and formulate his/her reason.

4. When the student is ready — typically in less than two minutes — he/she reads the situation and the options aloud to the rest of the group. The student gives the decision he/she has chosen, and briefly describes the reasoning involved. In turn, each of the other members of the group is invited to comment on the dilemma, and what he/she would do in the situation. The discussion of each dilemma by the members of the group should take about five minutes. The person whose dilemma is being discussed should have the opportunity to ask questions of the other members of the group, and to offer clarification about his/her decision. The discussion gives the students experience in having ideas examined by peers and is intended to remind the students of the need to take personal responsibility for decision making. It is not necessary and may not be desirable for the students to reach consensus; there are legitimately diverse views of the most appropriate and responsible actions to take in many situations. The purpose is to provide students with an opportunity to examine, express, clarify and take responsibility for their own reasoning.

Concepts:
Lessons on population, environment and society apply to daily personal decision making.

Objectives:
Students will be able to:
▶ Take positions on dilemmas.
▶ Formulate and present reasons for their positions.
▶ Discuss the dilemmas and positions in groups.

Subjects:
Science, Social Studies, Language Arts

Skills:
Decision making, critical thinking, writing, values clarification

Method:
While considering various dilemmas, students examine their own values and beliefs related to environmental issues, and evaluate possible actions they might take that have an impact on the environment.

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5. Continue this process until each student has had the opportunity to express his/her decision and rationale about a dilemma.

Tips for Adaptations:

1. Have students write their own Dilemma Cards, incorporating local issues and debates.

2. Cut off the suggested options on the Dilemma Cards and have students create their own responses.

Follow-up Activity:

Have each student choose a dilemma and write a short paragraph on the positive and negative effects of all the options listed for that dilemma. Students should indicate what additional information, if any, is needed to make a responsible and informed decision. Students should identify what seems, in their judgment, to be the most responsible decision — and explain their reasoning.

Based on the activity, "Ethic-Reasoning," appears in *Project WILD's Secondary Activity Guide*, Western Regional Environmental Council, © 1983, 1985, 1987.

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Here's Your Dilemma:

You are having a picnic with your family, and you see another family leaving to go home without having picked up their trash. It is clear the other family is going to leave litter all around. What would you do and why? Would you:

- move quickly and ask them to pick up the trash before they leave?
- wait for them to leave and pick up the trash for them?
- do nothing?
- other? (specify)

Here's Your Dilemma:

Your friend has just given you a lovely ivory necklace that she purchased on a trip to Africa. You are aware that African elephants are being slaughtered for their ivory tusks and are now an endangered species. What would you do and why? Would you:

- accept the necklace and wear it often?
- accept the necklace but keep it in a drawer?
- explain to your friend why you do not wish to accept her gift?
- other? (specify)

Here's Your Dilemma:

Your school cafeteria prepares food items that are popular with students (burgers, hot dogs, pepperoni pizza, fried chicken, etc.). You know that most of these items are high on the food chain, requiring lots of water and energy to produce. You are also aware that much of the grain produced in this country is used to feed livestock, while much of the world suffers from hunger and malnutrition. You also know that most of the students are more familiar with meat dishes than vegetarian meals. Would you:

- visit with school administrators to suggest having meatless lunches served at least once a week to save money and to force students to break their meat habits at least one day a week?
- bring your own lunch and not worry about the cafeteria menu?
- eat whatever is served?
- other? (specify)

Here's Your Dilemma:

Your parents make you mow and water your lawn. The area hasn't had much rainfall for some time and area officials are recommending that everyone conserve water. However, your neighborhood has strict rules about keeping each yard in order. Without regular watering your lawn will turn brown. What would you do and why? Would you:

- ignore the conservation warning and continue watering your lawn to keep it looking nice.
- sacrifice the beauty of your lawn by watering less often?
- plant different things in your yard that do not require so much care?
- other? (specify)

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Here's Your Dilemma:

You work at a restaurant and notice that each day meals are leftover and thrown away. You know that many people in your city are homeless and don't eat well. What would you do and why? Would you:

- suggest to management that leftover food be donated to a local homeless shelter?
- suggest to management that less food be prepared each day?
- do nothing?
- collect the food when the manager is not watching and give it to a homeless person down the street?
- other? (specify)

Here's Your Dilemma:

You were in the hall late one day and saw the janitor dump the recycling bin and the regular trash into the same dumpster. Would you:

- figure he's had a long day and let it go?
- take the time to explain to him how the bins were set up and why?
- mention it to a teacher or person in administration?
- not bother to separate your trash in the classroom anymore?
- other? (specify)

Here's Your Dilemma:

A friend asks you a question about sex and how to prevent pregnancy. Although you don't know the answer for sure, you know enough to guess. What would you do and why? Would you:

- make up an answer based on the facts you know?
- try to help find the answer in your health book or in a library?
- suggest your friend talk to his/her parents or a teacher?
- admit to your friend that you do not know for sure?
- suggest talking to a sibling?
- other? (specify)

Here's Your Dilemma:

The school you attend is not in walking distance from your home. Your parents have given you the option of catching the bus on the corner or getting a ride from one of them in the family car. The car would get you to school faster and without waiting outside. But the bus uses less gas per passenger. Would you:

- take the bus?
- get a ride in the car?
- carpool with other kids nearby?
- ride your bicycle?
- other? (specify)

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Here's Your Dilemma:

There is an undeveloped green space in your town where you and your friends sometimes go for peace and quiet. It's home to some local wildlife and a small creek. The town officials are thinking about selling the land to a developer who wants to build a shopping mall. The mall would provide some jobs at the shops and restaurants, especially for area teenagers. The mall might also be a place for you and your friends to hang out. What would you do and why? Would you:

- support the mall project at the expense of your green area?
- oppose the mall project altogether?
- go to a city planning meeting to see if developers would consider another site?
- do nothing and let the adults decide?
- other? (specify)

Here's Your Dilemma:

As your class is going to lunch, you notice that the TV, VCR and lights are still on. What do you do and why? Would you:

- turn off everything yourself?
- point it out to the teacher or principal?
- start a class discussion about saving energy?
- do nothing?
- other? (specify)

Here's Your Dilemma:

After months of pleading, you were given a pet iguana for your birthday. Along with the pet came a book discussing how to best take care of your pet. Until then, you and your parents were not aware that reptiles can live 25 or more years in captivity. Several months have passed and you are tired of feeding, watering and cleaning up after your new pet. What would you do and why? Would you:

- flush the iguana down the toilet?
- let the pet go outside knowing that it is an exotic species for your area?
- beg a friend to take your iguana without telling them about the long life of the pet?
- secretly drop the pet off on the door step of a local veterinarian?
- other? (specify)

Here's Your Dilemma:

You love children and would like to have a large family. You are aware, however, that the world's population is expected to double in the coming century. You are also aware of the financial and environmental cost of a large family. What would you do and why? Would you:

- plan to have a large family anyway?
- decide not to have children?
- limit yourself to one or two children?
- get involved with youth groups, scouts, tutoring, teaching or emergency foster care, to still be around groups of youngsters?
- other? (specify)

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Issues for the Global Family

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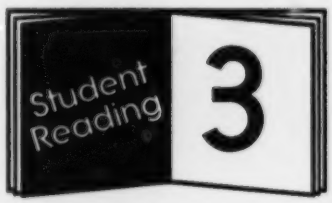
Global Family Ties



In Part 1, you were asked to think of all six billion people in the world as part of one very large family — a global family. Though we grow up in different parts of the world with different languages and customs, we all share the same basic needs and the same hopes for the future. We know that in order to live, all people need food, water, shelter and fuel. Many of us take these things for granted. But in much of the world and even here in this country (perhaps in our own communities), there are people who do not have enough to eat, have no home, or lack running water or fuel to heat their homes and cook their food. As the population grows, it becomes more difficult to make sure that everyone is able to meet his/her basic needs and that resources are shared fairly.

Rich and Poor

Living in a more developed country, many of us may take for granted having enough food to eat, good schools or medical care. Our world, though, is divided into rich and poor. One-fifth of the world's population enjoys relative wealth, while the other four-fifths have barely what they need to survive. Today, average yearly household income ranges from $400 in parts of Africa and Asia to over $30,000 in the United States.

Poverty means much more than not having a lot of money or luxury items, like nice cars and air conditioning. The world's poor also lack equal access to education, clean water, good nutrition and health care. The largest group of people who live in poverty are children. Fully two-thirds of the world's poor are under age 15. In less developed countries, the average family includes four children. As the world's population grows, the number of children living in poverty also increases.

This is why it is important for the size of the human population to be in balance with the Earth's other creatures and with our natural resources. As the human population grows, people need more land for building houses, factories, roads, schools and shops and for disposing of waste. They also need to produce more food to feed more people. But the Earth is finite. Whatever land is being turned into human habitat is taken away from animal and plant habitat. The result is smaller populations of fewer species. Already, scientists estimate that 100 plant and animal species become extinct every day!

Getting Enough to Eat

Perhaps a parent or grandparent has told you to eat all of the food on your dinner plate, because "there are starving children in India." You may wonder how eating your peas will help those children. What your

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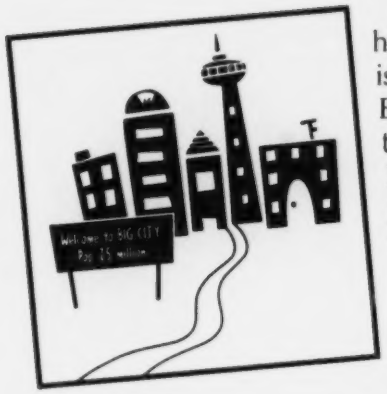
family may be trying to say is that you are lucky to live in a country where most people have enough food to lead healthy lives. About one billion people in the world are **malnourished**, not getting enough protein and other nutrients in their diets. This leads to poor health. Only about one-eighth (1/8) of all the land in the world is **arable** (able to be farmed). Not every country has enough good farmland to produce food for all its residents. Even with food being **imported** and **exported** around the globe, these resources are still not distributed equally. While farmers and scientists are always working to find ways to feed more people, their efforts are not able to keep up with the demand of 90 million more people on the planet each year.

In Search of a Better Life



Shortages of food and jobs, especially in less developed countries, have forced people to **migrate** from their homelands. Most of this migration is within countries from rural areas to cities where people search for jobs. Each year, 20 to 30 million of the world's poorest people move from rural to urban areas, especially to **megacities** in less developed countries. About 100 years ago, only 1 in 10 people lived in cities. Now, nearly half of the population live in cities. In the coming century, more people are expected to live in cities than live on the entire planet today.

Growing cities require more land, water and energy from surrounding regions to meet urban people's needs. Moving from the countryside to the city does not always bring improved living conditions. Rapid population growth has left many cities unable to provide needed services for all of the newcomers. Cities are often faced with difficult environmental and social problems, such as air and water pollution, traffic congestion, crime and poverty. In less developed countries, people from the rural areas move to the cities to find jobs. The poor usually live in slum areas that lack running water and safe living conditions.

Often people feel compelled to leave their homelands altogether and **emigrate** to another country in search of a better way of life for themselves and their families. In addition to economic pressures, people often migrate if they fear **persecution** for their religious or political views in their home countries. Tragically, many people around the globe lack basic human rights such as the right to an education, to be treated fairly by others and to live in a safe place.

People also move from their homelands if the environment there can no longer support a healthy quality of life. For instance, people flee from their homes to escape the destruction of natural disasters (such as floods and droughts) or human-made problems (such as polluted waterways or misused farmland).

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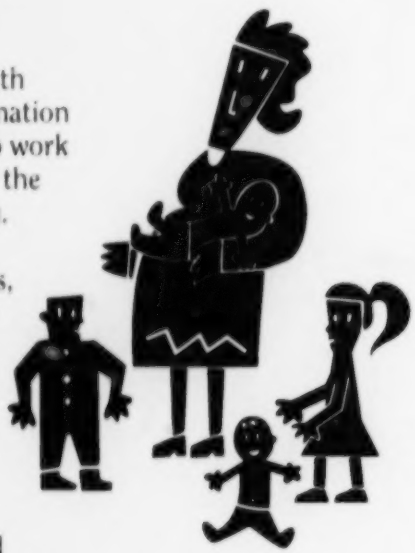
In search of a better quality of life, people in less developed countries sometimes move to more developed countries. When large numbers of immigrants move to a country, their need for food, water, jobs and services places huge demands on that country's economy and environment. In this way, population pressures, resulting from international migration, are felt throughout the world.

What About Girls?

So much of our health and well-being depend on where we are born and what opportunities are available to us. If you are born in a less developed country, the amount of education and health care you receive may also depend on whether you are a boy or girl. Because only men are considered for most jobs, boys are often the parents' hope for support in their old age. They tend to receive more attention and better care than their sisters, who often are denied an education.

In many countries, the custom is for the girls to stay at home to help raise younger children and do household chores. Most marry as teenagers and move away from their parents. Half of all girls in Africa and 40% of girls in Asia marry by the age of 18 and begin bearing children. As a result of no schooling, half of all women in less developed countries are **illiterate** (unable to read).



Studies from the United Nations have found that women with less education tend to have more children because they lack information about how to plan their family size. They also lack opportunities to work outside of the home and earn their own money. For many women, the only way to gain respect in their societies is to raise many children.

To help improve the **status** of women in developing countries, the United Nations has started programs to improve girls' education worldwide. Their goal is to have all girls and boys enrolled in primary school by the year 2015. In 1994, representatives from over 170 countries gathered in Cairo, Egypt, for the International Conference on Population and Development. They agreed to a Program of Action that states, "A healthy, educated woman is better able to participate in the development of her community and more likely to make or influence decisions about marriage and childbearing." The action plan also calls for equality between men and women in the workplace, voting rights, and rights to own land.

In planning for the future of people on our planet, it is important to make social equality a reality. This means narrowing the gap between rich and poor; helping all people provide for their basic needs; and providing equal opportunities for people regardless of race, religion, income, beliefs or **gender**.

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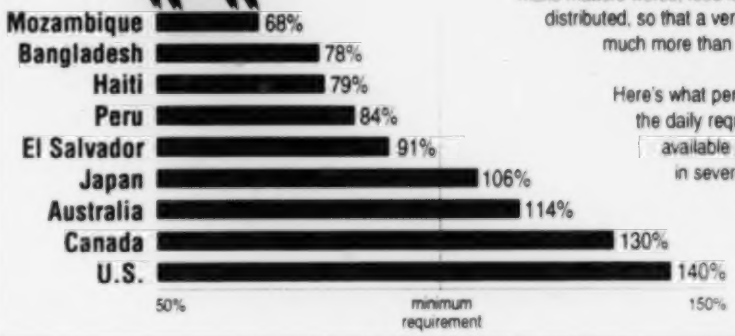
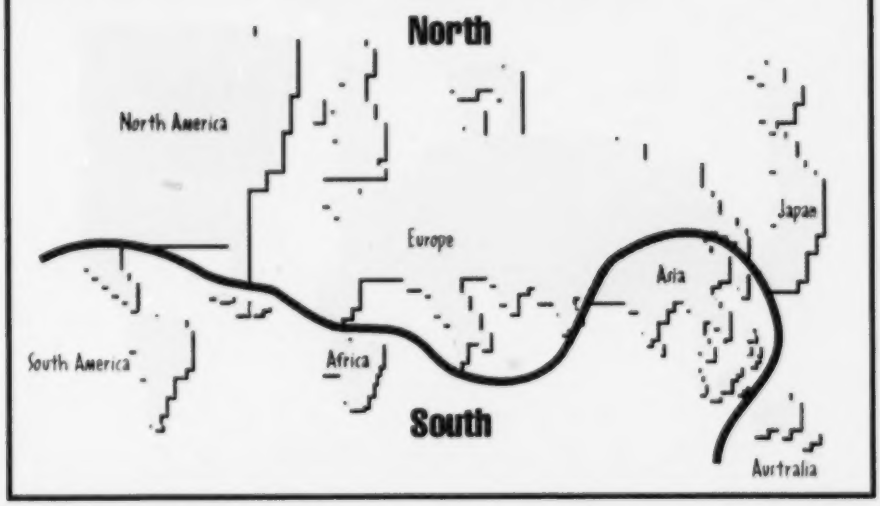
Who's hogging the calories? We are.

It takes approximately 2,500 calories a day to make the human body work the way it should. In some developing countries, there just isn't enough food to provide that requirement. And to make matters worse, food isn't equally distributed, so that a very few have much more than they need.

Here's what percentage of the daily requirement is available per person in several selected countries.



Portrait of a World Out of Balance



This map is an economic portrait of the world. It's based not on the geographical size of each country, but on the size of each country's per capita **gross national product** (GNP). GNP is one way of measuring the wealth available to each individual in a country. Note that when the world is drawn this way, it's obvious that the countries in the northern hemisphere are generally much richer than those in the southern hemisphere. In fact, it's just for that reason that people who deal with these issues are starting to talk about the world in terms of "North" and "South" rather than "East-West" or "First," "Second" and "Third World." Keep in mind that only 1/4 of the world's population lives in the North and 3/4 live in the South. Now compare the imbalance of wealth between North and South again.

Data source: World Vision Canada, Playing Fair? The Rules of World Hunger

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Reading Comprehension and Analysis:

1. What portion of the world's population is malnourished?

2. List three reasons why people might emigrate to another country?

3. How might the education of girls affect birth rates in less developed countries?

Glossary:

arable: refers to land that is able to be farmed.

emigrate: to leave one's country to live in another country.

export: to send items to another country for sale or trade.

gender: male or female.

illiterate: unable to read.

import: to receive items from another country to buy or trade.

malnourished: receiving less than the minimum amount of food for good health and growth.

megacities: cities with populations of ten million or more.

migrate: to move from one place to another.

persecution: causing people to suffer because of their beliefs or origin.

status: position or rank in relation to others.

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ACTIVITY 22

Food For Thought

Concepts:
Different regions of the world vary in population growth rates and the distribution of wealth and natural resources.

Objectives:
Students will be able to:
- State at least two factors that might be used to determine the relative well-being of a country or region.
- Identify at least two potential impacts of inequitable resource distribution.
- Define several demographic terms including birth rate, death rate, life expectancy.
- Draw correlations between population growth rate and wealth, and between wealth and energy use.

Subjects:
Social Studies, Science, Math

Skills:
Interpreting and analyzing demographic data, role playing, drawing connections

Method:
Students participate in a global simulation game that illustrates the inequitable distribution of population and resources among the different world regions.

Introduction:

This activity is designed to demonstrate how differences in population and resource use in five regions of the world combine to impact the quality of life for the people who live in each area. Population demographics, land use patterns, energy consumption and wealth are the issues that will be explored to heighten students' global perspective.

Materials:

Yarn or string (preferably in 5 different colors)
Masking tape
Ambassador's cards (provided)
2 Labels for each region; one says "Energy Consumption," one says "GNP" (see Region Information chart)
Transparent tape
28 oz. Hershey's Kisses
101 matches (or toothpicks)
10 sandwich bags
Overhead transparency on which terms A-K and their definitions appear (optional)

Procedures:

Preparation, the night before:

1. Measure out the yarn or string for each region according to the Region Information chart on page 129. You can use a different color yarn for each region, or, if you only have one color, make a tag to label each piece with the name of the region whose perimeter it will represent.

2. Count out the number of Hershey Kisses required for each region and bag them. Make labels for them according to the chart, and tape the appropriate label to each bag. Do the same for the matches.

3. Read through all the discussion questions and make notes to yourself about links to local, national and international current events. Seeing such ties between the activity and the real world will dramatically enhance the meaning the students glean from the exercise. As much as possible, you'll want to encourage them to make observations, critically evaluate the demographics, and hypothesize on possible causal relationships between the statistics.

   Your students will likely start a discussion of these issues themselves, but if they don't, the discussion questions will help to stimulate and/or direct class discussion. Because of the large amount of information in each section, it's best to discuss each group of statistics while they're fresh in the students' minds, rather than saving all discussion for the end.

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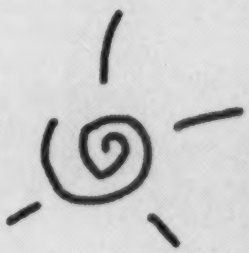
Region Information Chart

	North America	Latin America	Europe	Africa	Asia
Yarn Length	28ft.	32ft.	35ft.	45ft.	48ft.
1996 Population in millions[1]	295	486	728	732	3,501
With 56 Participants (1 = 100 million)	3	5	7	7	34
With 28 Participants (1 = 200 million)	1	2	4	4	17
Region's Percent of World Land Area[2]	14%	15%	17%	22%	23%
Percent of Region's Land That Is Arable[3]	12.5%	7%	15%	6%	16%
Per Cap. Energy Consumption[4] **(measured in barrels of oil)**	58 matches	7 matches	23 matches	2 matches	11 matches
Per Capita GNP[5] **1 Hershey's Kiss = $300**	$25,220 84 Kisses	$3,290 11 Kisses	$12,310 41 Kisses	$660 2 Kisses	$2,150 7 Kisses



Set up, just before class period begins:

1. Arrange the yarn on the floor to represent the regions and tape it in place.

   Note: The activity is designed for use with a group of either 25-30 or 56 participants. If your group will be in the 25-30 range, double the yarn over and knot it before arranging it on the floor.

2. Hide the bags of Hershey's Kisses and matches in a larger bag. Place the bag within easy reach of where you'll be standing as you lead the activity.

Introducing the Activity:

1. While students are still seated, read or paraphrase the following introduction:

   "All societies need and use natural resources such as land and energy, but the ways in which various societies use these things can differ greatly. For example, a small population may use an enormous amount of farmland or gasoline compared to the amounts used by other, much larger populations. This creates 'have' and 'have not' societies with potential for human discomfort and social conflict. The simulation we're about to do is going to demonstrate how this happens."

2. Appoint 5 students to be the "ambassadors" for the world regions. Give them their information cards and direct them to their regions.

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3. Populate the regions with the rest of the students, according to the chart. Given the length of the demonstration, you may wish to have students sit, rather than stand, in their regions.

Note: If you have too few students, you can use chairs to substitute for the missing citizens. If you have too many students, appoint the extra students to a "United Nations Advisory Committee." Instruct the members of the Committee to pay close attention, as you will be calling on them for their opinions as a neutral party later in the activity. They should be thinking in terms of whether the inequities in each region's share of population/food/income are problems, and if so, what policies could lead to solutions.

4. Identify each region by name for the class.

Note: The regions in this simulation are those defined by the United Nations and, therefore, Mexico is included in Latin America rather than in North America. Also, the sixth world region, Oceania, is not included because its population is so small relative to the others that it cannot be accurately represented.

5. Explain that the dimensions of their regions are to scale, and the number of students within each region is proportional to its actual population; the idea is to give an accurate sense of the population density in each area.

Facilitating the Activity:

For each of the sections that follow — Population Demographics, Quality of Life, Land Use Patterns and Energy Consumption and Wealth — use this basic procedure:

1. Review definitions of section's terms, referring students to the overhead transparency or chalkboard.

2. Review world statistics.

3. Offer any supplemental information provided.

4. For the first three sections (Population Demographics, Quality of Life, and Land Use Patterns) you will call on the ambassadors to read their regions' respective statistics. A sequence that works well is: North America, Latin America, Europe, Africa, Asia.

In the last section (Energy Consumption and Wealth), you will be distributing the bags of matches and Hershey's Kisses. It makes a more dramatic impression to start with the country whose amount is the smallest and continue in ascending order to the country whose share is largest. Referring to the labels on the bags, you will read aloud each region's quantity of each resource. Hold each bag up high so the whole class can see it before you pass it to the appropriate ambassador.

5. Review discussion questions.

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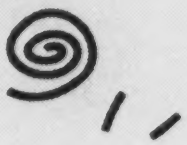
Population Demographics



I. Definitions: Terms A-E

A. **Population**: The number of people living in a region.[5]
B. **Birth Rate**: The number of births per 1,000 people per year.[7]
C. **Death Rate**: The number of deaths per 1,000 people per year.[8]
D. **Rate of Natural Increase**: Growth caused by having more births than deaths in a year (does not include immigration or emigration).[9]
E. **Doubling Time**: The number of years it will take a population to double in size if it maintains its current growth rate.[10]

II. World Population Demographics

a. The 1996 world population is 5.8 billion.
b. The birth rate is 24 per 1,000.
c. The death rate is 9 per 1,000.
d. The world's annual growth rate is 1.5%.
e. At this rate the world's population will double to 11.6 billion in 46 years.

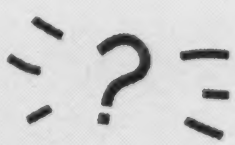
III. Supplemental Information

Regarding Population Growth Rates:

- A population grows whenever its birth rate is higher than its death rate.
- The growth rate is determined by the size of the difference between the birth and death rates. The closer these rates are, the lower the growth rate.
- Where birth and death rates are equal, the population's growth rate is zero.
- The world's current birth rate is almost three times its death rate.

IV. Ambassadors Read Statistics A-E from Their Cards

V. Discussion Questions



1. What will it mean to have our population double? What else will we need to have twice as much of to provide for all those people?

We'll need twice as much of everything people need to live:

- *food*
- *land to grow the food on*
- *clean water*
- *shelter*
- *energy to power our cars and heat our homes and cook our food ...*
- *schools*
- *hospitals*
- *roads*
- *cars*

2. Asia's doubling time is 43 years. If we returned in 43 years and did this exercise again, would we be able to fit twice as many people into Asia's space?

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Quality of Life

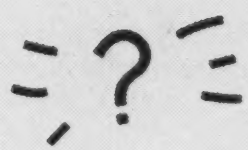
I. Definitions: Terms F-I

F. **Secondary School Enrollment Ratio**: The ratio of the percentage of each gender's population in the applicable age group (12-17 years of age) enrolled.[11]
G. **Total Fertility Rate**: The average number of children a woman will have in her lifetime.[12]
H. **Infant Mortality Rate**: The yearly number of children who die before reaching the age of one year per 1,000 live births. [13]
I. **Life Expectancy**: The average number of years a person born today could expect to live under current mortality rates.[14]

II. Worldwide Quality of Life

f. Of the world's 12-17 year olds, 58% of boys and 50% of girls are enrolled in school.
g. The world's women bear an average of 3.0 children.
h. The world infant mortality rate is 62 per 1,000.
i. The average human life expectancy at birth is 66 years.

III. Ambassadors Read Statistics F-I from Their Cards



IV. Discussion Questions

1. Can you see any connection between Africa's unusually high infant mortality rate of 91 per 1,000 (almost 1 in 10), and its high total fertility rate of 5.7 children per woman?

   - *When people know each of their children has about a 10% chance of not surviving to adulthood, they will have more children to increase the likelihood that some will survive.*
   - *This is especially crucial for people living in societies where there is no social security and no retirement plans, where the elderly are entirely dependent on their children for care and financial support.*

2. Infant mortality rates are consistently lower in regions in which girls have access to higher education. Is this coincidental, or is there a correlation here? What abilities and/or knowledge do educated people have that might be useful to them as parents?

   Literacy (including reading and basic math): Parents with these abilities can:
   - *read directions, such as those on over-the-counter medicines and infant formula.*
   - *educate themselves about any subject, including child development and care.*
   - *get better jobs and earn more money.*

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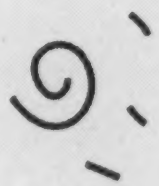
Health/Biology: Exposure to these subjects makes people more aware of how to take good care of themselves and their children. They understand the importance of:

- *good nutrition*
- *medical care, especially perinatal care*

3. What do indicators like a high infant mortality rate and short life expectancy say about the quality of life in a region? What are some possible causes?

Possibilities include:

- *Food that's insufficient in quantity or nutritional value*
- *Lack of clean water*
- *Low quality medical care or none at all*
- *Exposure to high levels of pollution*



Land Use Patterns

I. Definitions: Terms J and K

J. **Urban Population**: Percentage of the total population living in areas termed urban by that country (typically towns of 2,000 or more or in national or provincial capitals).[15]

K. **Arable Land**: Farmland; land capable of growing crops.[16]

II. Worldwide Land Use Patterns

j. 43% of the world's population (about 2.5 billion people) now live in urban areas.

i. There are 0.6 acres of arable land per person on Earth.

III. Supplemental Information

Regarding Urbanization:

- By 2025, the number of the world's people living in urban areas is expected to double to more than 5 billion.
- 90% of this growth will occur in the developing world.
- Almost 75% of the population in the developed world already lives in urban areas.
- In the developed world — especially North America — most of the current population shift involves people moving away from concentrated urban centers to sprawling suburban and metropolitan regions, or to small and intermediate-size cities.[17]

Regarding Arable Land:

- The lowest authoritative estimate of the minimum amount of arable land required to feed one person — without intensive use of synthetic fertilizers — is 0.17 acres.[18] (This doesn't include crops for textiles or cash crops needed for income.)

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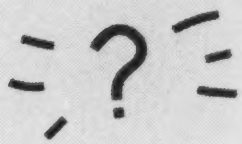

IV. Ambassadors Read Statistics J and K from Their Cards

V. Discussion Questions

1. How will population growth affect the amount of arable land available per person?

   When people share a limited resource such as arable land, each person's share of that resource becomes smaller in direct proportion to the number of additional people using it.

2. What would it mean for a country to have its amount of arable land per capita fall below the minimum required to grow enough food to sustain its population?

   Such a country would become dependent on imported foods, making it vulnerable to price hikes and shortages.

3. What do you think usually causes people to move to cities?

   The shift of jobs from agriculture to industry and services — leading to a concentration of economic opportunities in urban areas.

4. What are some possible positive and negative effects of having such large proportions of countries' populations shifting to urban areas?

   Positive Effects:

   More green space is left open for:
   - *other species to inhabit.*
   - *trees and other plants to continue producing the oxygen we all need.*
   - *potential farmland.*

   Well-planned cities can offer people:
   - *more job opportunities.*
   - *better public services and living conditions.*

   Negative Effects:

   When a city's population grows very rapidly, two major effects are likely:

   Higher rates of unemployment and poverty
   - *occur when more people come looking for work than there are opportunities available.*
   - *can happen in spite of economic growth.*

   Greater environmental problems:
   - *infrastructure facilities and services can't expand quickly enough to keep up with increased demand.*
   - *streets become congested, levels of pollu- rise, sanitation systems are overwhelmed, and residents' health and general quality of life decline sharply.*

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Energy Consumption and Wealth

I. Definitions

L. **Energy Consumption**: The total amount of energy used by each region per year divided by the number of people living in that region — includes industrial use.[19]

M. **Gross National Product**: A commonly used measure of a nation's wealth, determined from the annual profits generated within a region by all goods and services exchanged that year.[20]

II. Symbolism of Props

Regarding the matches:

- While energy is provided in many ways, including wood, coal, natural gas and nuclear power, in this activity, all these sources have been combined and are expressed in terms of barrels of oil.
- These matches represent the average amount of energy consumed by each citizen of each region in the course of a year.
- Each match = 1 barrel of oil. One barrel contains 55 gallons.

Regarding the Hershey's Kisses:

- The Kisses represent the amount each person would get per year if his/her region's annual GNP were divided equally among all its citizens, expressed here in U.S. currency. This is also considered to be an indicator of average annual income.
- Each Kiss = $300.

III. Distribute Bags to Ambassadors

- Start with the country whose amount is the smallest and work up to the country whose share is largest.
- Hold each bag up high so the whole class can see it.
- From the labels, read aloud each region's quantity.

IV. Instruct Ambassadors to Distribute the Candy Among Their Citizens

- Expect and allow students to migrate and ask for aid.
- Assist them in making connections between their reactions to the simulation and real-world phenomena.

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V. Discussion Questions

1. What would it be like in this room if we lit all these matches?

2. Who would have to breathe all that smoke? Would only the citizens of North America be breathing the pollution generated by their 58 matches?

3. What do the people in our Asian and African regions think about the fact that the North Americans have a bag bulging with wealth, when they have so little?

4. How could/do people from regions with less wealth and opportunity get access to those things?

5. What does the North American Ambassador think about the uneven distribution of wealth? What does he/she want to do about it?

6. How will the wealthier regions decide to which countries they will offer foreign aid? What, if any, conditions will you impose on nations receiving your help? Will you trust the countries receiving money from you to put it to good use, or will you attempt to control what is done with it?

7. How will the less densely populated regions decide from which countries they will accept immigrants? What, if any, conditions will you impose on people seeking permission to immigrate? Will you accept only very well-educated people, or will you base your decision on need — giving preference to those with the least opportunity in their home countries? Or those suffering political persecution? Or refugees from war-torn nations? Or would it be based solely on numbers, first-come, first-served?

8. In the process of eating the Hershey's Kisses, which region generated the most empty wrappers? Do you think this is an accurate representation of how much garbage each country creates as a function of its wealth and consumption?

9. [Good for the United Nations Advisory Committee, if you have one.] What does the group think should be done about the inequitable distribution of wealth and consumption of resources? Do donor nations have the right or obligation to link aid to certain policies that might enable recipient countries to become self-sufficient in the future? What might those be? Should rich countries be required to reduce their consumption levels? How could this be encouraged or enforced? What should be done about environmental problems (acid rain, ozone depletion) caused by one region, but affecting others?

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Sources:

[1,3,15,20] "1996 World Population Data Sheet." Population Reference Bureau, Washington, DC, 1996.

[2,4,16,17] Roberts, Leslie, Ed., *World Resources 1996-97*. The World Resources Institute, The United Nations Environment Programme, The United Nations Development Programme, and The World Bank. Oxford University Press, New York, 1996.

[5,19] The World Bank, *World Development Report 1995*. Oxford University Press, New York, 1995.

[18] Engelman, Robert, and Pamela LeRoy. *Conserving Land: Population and Sustainable Food Production*. Population Action International, Washington, DC, 1995. p. 9.

North American Ambassador Card

I am the North American Ambassador.
Here are some statistics that shape my region of the world:

A. North America's population is estimated at: 295 million
B. Our birth rate is: 15 per 1,000
C. Our death rate is: 9 per 1,000
D. Our annual growth rate due to natural increase is: 0.6%
E. At this rate our population will double in: 114 years
F. Of our 12-17 year olds, 99% of the boys and 98% of the girls are enrolled in school.
G. North American women bear an average of: 2.0 children
H. Our infant mortality rate is: 7 per 1,000
I. Our life expectancy at birth is: 76 years
J. The percentage of our people living in urban areas is: 75%
K. Acres of arable land available per person: 2.0 acres

Latin American Ambassador Card

I am the Latin American Ambassador.
Here are some statistics that shape my region of the world.

A. Latin America's population is estimated at: 486 million
B. Our birth rate is: 26 per 1,000
C. Our death rate is: 7 per 1,000
D. Our annual growth rate due to natural increase is: 1.9%
E. At this rate our population will double in: 36 years
F. Of our 12-17 year olds, 50% of the boys and 53% of the girls are enrolled in school.
G. Latin American women bear an average of: 3.1 children
H. Our infant mortality rate is: 43 per 1,000
I. Our life expectancy at birth is: 69 years
J. The percentage of our people living in urban areas is: 71%
K. Acres of arable land available per person: 0.7 acres

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European Ambassador Card

I am the European Ambassador. Here are some statistics that shape my region of the world:

A. Europe's population is estimated at: 728 million
B. Our birth rate is: 11 per 1,000
C. Our death rate is: 11 per 1,000
D. Our annual growth rate due to natural increase is: -0.1%
E. At this rate our population will not double.
F. Of our 12-17 year olds, 89% of the boys and 94% of the girls are enrolled in school.
G. European women bear an average of: 1.5 children
H. Our infant mortality rate is: 11 per 1,000
I. Our life expectancy at birth is: 73 years
J. The percentage of our people living in urban areas is: 74%
K. Acres of arable land available per person: 0.5 acres

African Ambassador Card

I am the African Ambassador. Here are some statistics that shape my region of the world:

A. Africa's population is estimated at: 732 million
B. Our birth rate is: 41 per 1,000
C. Our death rate is: 13 per 1,000
D. Our annual growth rate due to natural increase is: 2.8%
E. At this rate our population will double in: 25 years
F. Of our 12-17 year olds, 36% of the boys and 30% of the girls are enrolled in school.
G. African women bear an average of: 5.7 children
H. Our infant mortality is: 91 per 1,000
I. Our life expectancy at birth is: 55 years
J. The percentage of our people living in urban areas is: 31%
K. Acres of arable land available per person: 0.6 acres

Asian Ambassador Card

I am the Asian Ambassador. Here are some statistics that shape my region of the world:

A. Asia's population is estimated at: 3 billion, 501 million
B. Our birth rate is: 24 per 1,000
C. Our death rate is: 8 per 1,000
D. Our annual growth rate due to natural increase is: 1.6%
E. At this rate our population will double in: 43 years
F. Of our 12-17 year olds, 57% of the boys and 45% of the girls are enrolled in school.
G. Asian women bear an average of: 2.9 children
H. Our infant mortality rate is: 62 per 1,000
I. Our life expectancy at birth is: 65 years
J. The percentage of our people living in urban areas is: 33%
K. Acres of arable land available per person: 0.3 acres

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ACTIVITY 23

The Hunger Banquet

Introduction:

This luncheon-game is meant to simulate for students some of the inequities of the present socioeconomic world situation and some of the feelings of helplessness and frustration that result from these inequities. By enabling the participants to deal with a concrete experience of purchasing power, the exercise becomes a learning tool that explores global imbalances. Through this luncheon, students will become more familiar with the disparity of resources around the world and may then make the links to the disparity of resources in the United States.

Materials:

For a class of 30 students
Food (see menu on page 143 for items needed — you will need larger quantities of the cheaper items, since most students will only be able to afford those)
3 tables (one buffet-style for food, two for eating)
1 tablecloth and table furnishings (centerpiece, etc.)
10 chairs
200 "chips" (small squares of cut paper)
30 "1/2 chips" (small squares of a different color cut paper)
15 visas (small cards marked "visa")
4 Industrial/First World Role-Identity Cards (provided)
3 Transitional/Second World Role-Identity Cards (provided)
23 Developing/Third World Role-Identity Cards (provided)
30 menus (or one large menu posted for the class) (provided)

Procedure:

Set-up:

The game is best played with at least 30 people in order to have a visible proportion of rich and poor. It is a good exercise to coordinate with other classrooms during lunch period or on activity night. You might use the following figures in proportioning your players and resources.

	Population Distribution	Players	Wealth Distribution+	Chips
Industrial/First World*	15%	4	80%	40
Transitional/Second World*	10%	3	15%	8
Developing/Third World*	75%	23	5%	3

*Economic classification based on per capita GNP as listed in The World Bank, *World Population Projections 1994-95*. (First World: $8,356 or more; Second World: $2,696-8,355; Third World: Below $2,695).
+Wealth distribution based on a comparison of per capita GNP averages as outlined above and as differentiated by reliance on the export of raw materials to earn foreign exchange. The classifications and income concentrations are cited from *World Resources: A Guide to the Global Environment 1996-97*.

Concepts:
Much of the world suffers from chronic hunger and malnutrition due to population pressures and the inequitable distribution of food and wealth.

Objectives:
Students will be able to:
▶ Discuss their reactions to the inequities of the luncheon in a debriefing session.
▶ Express their values as they respond to the global distribution of population, wealth and food.
▶ Understand the global disparities of resources as well as the disparity of resources within their own communities.

Subjects:
Social Studies, Family Life Education

Skills:
Communication, bargaining, conflict resolution, strategic planning, writing

Method:
Students participate in a luncheon-game that simulates inequities in the global distribution of food and wealth.

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You will have to adapt these figures if you have more or fewer players, but you can base this on the population distribution. The figures are estimates drawn from multiple sources and therefore you may want to draw more precise figures on particular countries from the cited sources.

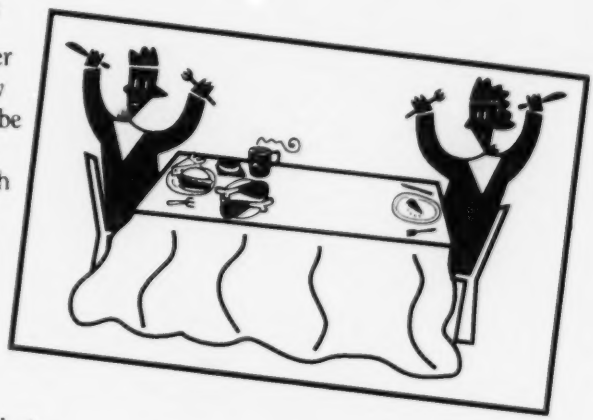
There should be two persons available for selling food and visas.

The game is prepared around the setting of a luncheon buffet. Feel free to adapt the menu provided.

The food or buffet table should be made to look as attractive as possible. A beautifully furnished table and chairs should be placed in a corner of the room for the Industrial/First World players. Provide a modest table and chairs for the Transitional/Second World players. The Developing/Third World players should be confined to a small unfurnished section of the room, providing only chairs or sitting room on the floor. There should be a clear difference in the three settings.

Prepare envelopes for each student including a Role-Identity Card and the proper number of chips according to the table. Also, you might include a menu in each envelope. Extra chips can be used by the food and visa sellers for change.

Facilitating the Activity:



1. Give each player his/her materials. If you know the students, it might be a good idea to place a vocal individual in each of the three "worlds." Should you not know the players, simply give a set of materials to each player at random.

2. Tell the participants that:
   a. This is a simulation game approximating the distribution of wealth, population and food as it is in the real world.
   b. They are to deal with the situation as they see it, and enjoy the meal.
   c. There are no rules other than those on their Role-Identity Cards.

3. The dilemma of how to deal with the inequities of the food and wealth distribution may take various forms. The group may immediately take on a "just and humane" style and work toward providing every player with an equal or adequate share of food. This is "the ideal" and will not necessarily happen. It might happen that the game results in "confrontation" or "revolution." In that case, it should be resolved by having the sides draw up a statement of "grievance" or "justification," etc. This should express both their feelings and their plan to resolve the situation.

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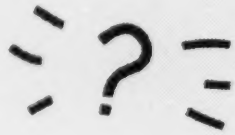
The facilitator should judge when the game has been played out and declare it over. At the finish, it is important to invite the players to drop the rules and share the food. However, you might want to let the inequality go unresolved. This would not be recommended if the session were to be lengthy. This is an exercise in exploring difficult issues, not frustrating students.

Debriefing:

The debriefing session is very important and the facilitator needs to draw out students' reactions and synthesize their perceptions and insights. Also, after the group debriefing session, have students write about their personal experiences and responses. This should be a non-graded exercise that could either be handed in or shared in small groups. The debriefing should motivate students to study the complex problems of the global and local situations.

Discussion Questions:



1. What was your emotional reaction to the rules? To the rules of the other groups?

2. How did you feel toward the people in the other groups?

3. Did you agree with the manner in which your group resolved the problem? Do you think it was "realistic?"

4. Did your feelings change significantly during the experience? If so, when? Why?

5. Does the global situation make you think about your own community?

6. Is the distribution of resources in the United States equal?

Follow-up Activities:

1. Have students list 3 things they can do as individuals to work toward more equitable food and resource distribution worldwide.

2. Have students extend this list to 3 more things they can do as individuals within their own communities.

3. Design an extra-credit project for students to volunteer at a soup kitchen or at other community service projects.

4. Celebrate World Food Day on October 16 by facilitating this exercise in order to engage students with the issues and to heighten awareness around your school. Contact the U.S. National Committee for World Food Day at 1001 22nd Street, Washington, DC 20437; (202) 653-2404.

Adapted with permission from the Americans Friends Service Committee. The original activity, "Simulation Game," appears in *Hunger on Spaceship Earth*, The American Friends Service Committee, New York Metropolitan Regional Office.

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HUNGER BANQUET ROLE-IDENTITY CARDS

Welcome to the First World ...

You are a privileged citizen of countries such as Japan, Germany, Australia and the United States. You are part of the 15% of the world's population who lives in the industrial world and you have an almost unlimited access to the goods of the Earth.

You are invited to enjoy the luncheon we have prepared for you. You have been given 40 chips, which entitle you and your fellow First World citizens to enjoy most of all that is being served because as a citizen of a high income nation you have control of almost 80% of the world's wealth.

Because you enjoy a high level of well-being, health, literacy and wealth, you are granted an unconditional visa to travel anywhere you choose. However, each time you visit the Second World, you must donate 1 chip to the country, and each time you visit the Third World, you must donate a 1/2 chip.

Welcome to the Second World ...

You are a member of the "transitional" peoples of the world, a citizen of one of the progressing industrialized countries — such as South Africa, Slovenia, Malaysia and Brazil — where you enjoy 15% of the world's wealth. You are part of the 10% of the world's people who have been given a relative buying power in your packet of 8 chips. Please feel free to purchase whatever you can from the luncheon table.

Since you enjoy a growing level of literacy, good health and wealth, you are free to travel to the countries of the First or Third World under these conditions:

1) You must travel in pairs.
2) Visa must be purchased at luncheon table. One chip must be deposited at luncheon table for each visa, and no more than 2 people may be issued visas at a time.

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Welcome to the Third World ...

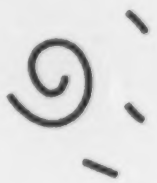
You are hereby classified as a citizen of the developing world. Unfortunately, that will be of some disadvantage to your participation in this luncheon for you have only 5% of the world's wealth.

Since you make up 75% of the world's population, it is not quite possible for you to have full freedom in consumption of the Earth's resources, or in fact, of our luncheon. You are entitled to a small fraction of the Earth's goods and have been given a relative buying power of 3 chips. We encourage you to be creative in your efforts to increase your buying power, perhaps through combining your chips.

Due to your high level of disease and illiteracy as well as your lack of wealth, we regret to inform you that your ability to travel is restricted.

Cost: Visa to Second World - 7 chips
Visa to First World - 9 chips

Visas may be purchased at the luncheon table.



MENU

Item	Size	Cost
Meat	1 slice	4 chips
Cheese	1 slice	4 chips
Salad	1 portion	3 chips
Bread	1 slice	1/2 chip
Pastry	1 portion	5 chips
Rice dish	1 portion	1 chip
Raisins	1 portion	1/2 chip
Cracker	1 portion	1/2 chip
Fruit	1 portion	3 chips
Tea	1 cup	1 chip
Juice	1 cup	2 1/2 chips
Milk	1 cup	1 chip
Sugar	1 teaspoon	1/2 chip
Condiments	1 teaspoon	1/2 chip

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ACTIVITY 24

For The Common Good

Concepts:
Sustaining our natural resource base requires conservation and the cooperative use of resources held in common.

Objectives:
Students will be able to:
▶ Identify a strategy that would produce a sustainable use of resources in a simulation game.
▶ Draw parallels between the chips used in the game and renewable resources upon which people depend.
▶ Draw parallels between the actions of participants in the games and the actions of people in real-world situations.

Subjects:
Social Studies, Science, Language Arts

Skills:
Finding cooperative strategies, following directions

Method:
In a simulation, students desiring to draw renewable resources from a common pool determine short-term consumption strategies that will preserve a long-term supply of the resource. Given a hypothetical situation about resources, students must decide what is in the best interest of themselves and their classmates.

Introduction:

Renewable resources, such as trees or fish, can be maintained if managed properly. But if not given an opportunity to reproduce, these resources can be exhausted quickly, especially as the demand for the resources grows. In managing these resources, it is important for people to use them cooperatively and to not sacrifice long-term gain for short-term profits. In the first part of this activity, students play a game where cooperative decisions must be made if all are to benefit. Note: It is best to play the game first without telling the students that the chips represent resources that must be shared. Part 2 reinforces the concept that cooperation, rather than selfishness, brings more long-term benefits to the society.

Materials:

Tokens (such as poker chips or peanuts in the shell)
10 tokens per student should be available altogether
Hard candies, stickers or something the students value highly
Stopwatch or watch with a second hand
CD or tape player for playing music
CD or tape of lively music (at least eight minutes worth)
Paper and pencils or pens

Part 1: Something for Everyone

Procedure:

1. Count out, but do not distribute, 10 chips for each student playing the game. Put one-fourth of them in a separate pile.

2. Seat the students in a circle.

3. In the center of the circle, place the pile comprising one-fourth of all the chips. For example, if you have 10 students, you use 100 chips and begin with 25 in the center.

4. Read the following rules twice to the students.

Rules:

1. The chips belong to all of you.

2. Music will be played, and while it is playing, everybody may take chips out of the pool of chips in the center.

3. You may trade in 10 chips for a piece of candy (or sticker).

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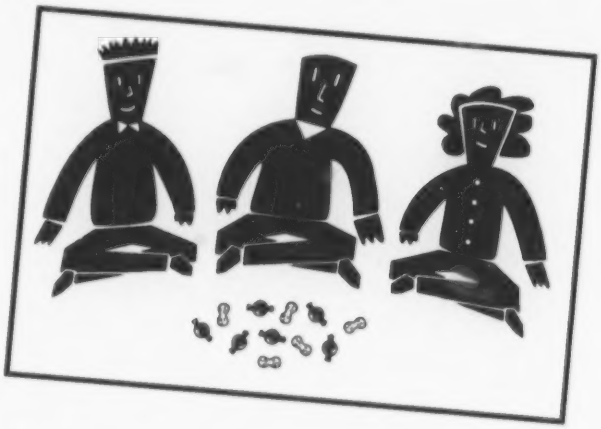
4. As soon as the music stops, I will double the number of chips left in the pool at that time, and then continue the game.

5. There will never, however, be more chips in the pool than there are at the start of the game; this is the maximum number of chips the pool can hold.

6. You may not talk to anyone during the game.



Notes to the Teacher:

DO NOT explain the significance of the chips before playing the game. The rules are the only instruction the players get.

The players will most likely empty the pool at the start of the game. Point out that, as it's impossible to double zero, the game is over. Ask if they'd like to try again. Each student must return all of his/her chips to the pool.

Continue to play the game for several rounds without giving the students time to communicate with one another in between.

When doubling the chips in the pool, remember there can "never be more chips in the pool than at the start of the game." This is the pool's *carrying capacity* for chips.

After several rounds, you may allow the students to talk while the music plays so they can discuss strategies.

After five or six rounds, ask students how they feel about the way the game worked out. As a group, help students think of ways they could cooperate to allow more of them to get their 10 chips without depleting the pool of resources. Play again using the strategies developed by the students.

Discussion Questions:

1. What do the chips represent?

Renewable resources, such as fish or trees. (Coal, gasoline, oil and iron are

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examples of nonrenewable resources, and therefore aren't applicable in this exercise.)

2. Can we draw any parallels between the way the group treated the chips and the way individuals and society as a whole use or overuse renewable resources?

   Deforestation: *cutting trees down without planting replacements or at a rate that does not give new trees enough time to grow to maturity before harvesting.* **Overfishing:** *taking so many fish that not enough are left to reproduce and replenish the stocks for next year.* **Overfarming:** *depleting the soil of nutrients without giving it time to regenerate.*

3. How many chips were taken out of the pool in the different game variations? How many candies did this generate? How did it make you feel about other members of the group?

4. How did talking about the game make you play differently? After discussing strategies, did it seem that differing attitudes were behind the different ways you played the game? Why did some players take as many chips as they could reach and others left some behind? How did this make you feel?

5. Have you experienced a similar situation at home, with friends, in your community? *(It may help to provide an analogy, such as several people in the house competing for hot water in the morning.)* How, in the long run, can more benefit if individuals refrain from taking too much? What sort of attitude do we need to have to achieve the goal of the greatest benefit for all?

Part 2: A Social Dilemma

Procedure:

Distribute small pieces of paper and instruct the class that they are to choose to write a C or a D on the papers after listening to the following guidelines:

1. If you write a C, I give you nothing, but I give everyone else in the class a dollar (pretend money).

2. If you write a D, I give you $2, but I give everyone else nothing.

3. None of you is allowed to see what anyone else has written.

4. The result is that *you'll* get however many dollars you gave yourself, *plus* however many dollars everyone else gave you.

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Again: you'll each get $1 for *everyone else* in the class who writes C, plus $2 if *you yourself* write D.

Give them a short time to make their decisions and write C or D. Then tell them to consider the following two points:

1. If everyone puts down a C, each of you gets a dollar for everybody in the class except yourself. That's how many dollars?
   (The number of students in the class minus one.)

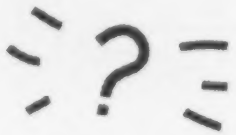
2. If *everyone* puts down a D, *everybody* gets only $2. Anyone who would like to change his/her answer may do so now.

Give students time to reconsider and change their answers if they so choose. Then ask the students to reveal their final choices, whether they've changed and why.

Notes to the Teacher:

This type of situation is called a social dilemma. Everyone does best if all cooperate (the C option), but each gets a little more money by acting selfishly, or defecting (choosing D). It is a common situation. Students who understand the theory of social dilemmas will be better able to understand the need for solutions to them.

Discussion Questions:



1. C stands for *cooperating* and D for *defecting*. How would you feel if you cooperated and everyone else defected?

2. How would you feel if you defected and everyone else cooperated?

3. In this game, when do all the participants get the most? The least?

4. What are some examples of C-type (cooperative) behavior in the real world?

   Contributing to public TV, not trying to evade the law, keeping promises, doing one's job wholeheartedly in the absence of supervision, not taking more than one's share of a public resource, not polluting the air and not having too many children. The D response corresponds to the opposite choice in each case.

5. Think of a real-life social dilemma in which too few people cooperate. How could people be encouraged to cooperate more?

Part 1 adapted with permission from an activity developed by Kurt and Ursula Frischknecht and Karen Zimbelman in *Thinking Globally and Acting Locally: Environmental Education Teaching Activities* by Lori D. Mann and William B. Stapp, ERIC/SMEAC, ©1982.

Part 2 adapted with permission from an activity developed by Jonathan Baron, Decision Science Consortium, Inc., Reston, VA, 1988.

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ACTIVITY 25

People On The Move

Concepts:
People throughout the world migrate to improve their quality of life.

Objectives:
Students will be able to:
- Identify "push/pull" factors that influence people's decisions to move.
- Use inductive reasoning to draw conclusions about migration at large.
- Evaluate the activity as a model for migration and identify limitations.
- Express their reactions to the activity.
- Determine a fair method of rectifying the activity's "injustice."

Subjects:
Social Studies

Skills:
Observation, critical thinking, inductive reasoning, sharing experiences, problem solving

Method:
Students participate in a brief simulation that helps them identify some of the reasons that people migrate from one place to another.

Introduction:

Population pressures throughout the world have encouraged migration, the movement of people from one place to another. While most people might prefer to stay in their homeland, they often feel compelled to leave in search of a better quality of life somewhere else. This activity is designed to take a closer look at the causes of migration, the "push/pull" factors that repel people from and/or attract people to various regions. Push factors may include economic hardship, social or cultural discomfort (from exclusion or hatred), violence, an unhealthy environment and a harsh climate. Pull factors may include economic opportunity, security, social or cultural comfort (from inclusion or caring), cultural amenities, natural beauty and a milder climate.

Many people emigrate from one country to another in search of a better way of life. Most people on the move throughout the world migrate within their own countries, often from rural to urban areas in search of jobs. Automotive and airplane technologies have encouraged and opened up the possibility of internal migration at unprecedented levels. In the first half of the 1990s, one in ten Americans moved from one state to another. One in three people moved within their state. What is at the root of this mobility? Why do people change locations? Are there parallels that can be drawn between internal migration (within a country) and international migration (from one country to another)?

The lesson begins with a brief simulation activity illustrating a prime reason people migrate (more opportunities in another place) and then moves to a class discussion.

Materials:

About 150 pieces of candy
Masking tape (optional)

Procedure:

1. Draw a line using tape or chalk that separates the class in half. Explain the rules:

   "This line should be considered a boundary defining side A and side B. One by one I am going to distribute the candy to students on side A. Eventually you may eat your candy, but please refrain from doing so until I say it is time. If any person is caught grabbing pieces from another person or throwing the pieces, he or she will face a penalty. Any student may choose not to accept his or her allocated candy. Of course, general respect is expected from everyone."

2. Circulate around side A and distribute the candy one at a time. Carry the bag with you to show a limited supply. Give candy only to students on side A. Avoid using the terms "side A students" and "side B students" because

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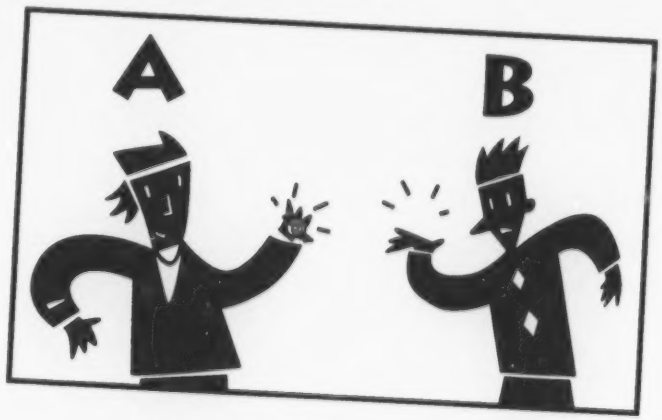
they imply a fixed identity. The object is to communicate that they are or are not receiving candy based not on *who* they are, but *where* they are.

There may be questions or objections to the procedure. If needed, calmly explain that *the nature of the activity is to distribute the items unevenly.* People on side A receive candy; people on side B do not. If students on side B ask for some, tell them that you cannot give them any because they are not on side A. Do not discourage friends from sharing across the border, as long as they do not throw the candy. Also do not discourage students from moving across the border. Distribute candy to any student who moves to side A once he/she has settled in a fixed spot.



Do not give any candy to students who move to side B. Do this until you have distributed all the candy pieces.

The expected result is that, by the end of the activity, some students will have moved from side B to side A. At the end of this activity, refrain from moving people back to their seats unless necessary.

Discussion Questions:

Part 1: Observations — What happened?

1. Did anyone switch sides? How many from A to B? How many from B to A?

2. Did anyone share pieces of candy with someone else?

3. Did anyone break the rules (i.e., grab or throw candy, eat candy before teacher gave O.K.)?

4. Did anyone try to receive candy out of order?

Part 2: Reactions — How did/do people feel?

1. Describe your reactions during the activity (i.e., what you were thinking/feeling).

2. Was anyone angry? What or who was the object of the anger?

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3. Assuming students switched sides: How did people on side A feel about people switching sides? How did people on side B feel about people switching sides?

4. If there was an infinite amount of candy, would feelings be the same?

5. For the students who switched to side A, what determined specifically where you went on side A?

6. Did anyone like/dislike the teacher during this activity? Why?

7. For the students who received the most pieces, how do you think you would have felt if you had been given the same number you have now, but side B had been given double that number?

Part 3: Interpretations — What does it mean?

1. What do you think this exercise was designed to demonstrate?

2. In the real world, what might the pieces of candy represent?

3. In the real world, what might the two sides represent?

4. Consider someone on side A who decided not to play by the rules. What might that represent?

5. Consider if that person were caught and moved to side B or out of the game. What might side B represent? Who or what might the teacher represent?

6. Brainstorm two lists on the board for migration push factors and pull factors. Based on this activity, what would you say is the major reason that people migrate? How would reasons for migrating from one place in the United States to another be the same as reasons someone might migrate from another country into the United States. How might they be different?

Part 4: Critical Thinking

1. Who in the class has moved from another country or state in his/her lifetime? Why?

2. Think about your ancestors. Where did they come from? Why did they migrate?

3. What are some of the limitations of this simulation? What important migration factors did the activity not demonstrate?

Simply moving to a wealthier region or country does not ensure a better quality of life, at least not right away. It often takes more than one generation for immigrants' socioeconomic status to approach that of the "average" American. They often must learn a new language and/or secure new job skills to earn more money. Also, people who migrate "illegally" are denied opportunities.

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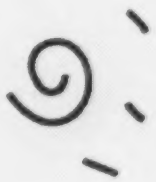
The simulation primarily demonstrated the push/pull factors of migration that relate to wealth and better opportunities. It did not address other factors such as political, cultural and religious persecution; war; and healthier environment.



4. There are big differences in resources between people in almost every society, yet the poor often do not migrate and become neighbors with the wealthy as this activity would seem to indicate they might. Why is this?

5. Why does this resource difference exist? Should we try to alleviate this difference? Can we? How?

6. There is a resource difference (of candy) in this room. What should be done?

This last question is a valuable problem-solving activity, and, as much as possible, it should be left to the students to decide upon and implement a plan. Help them implement whatever plan they choose (equal redistribution for instance), but do not impose a decision; help them decide their own.

The last step after redistribution, of course, is to eat the candy.

Note to the Teacher:

When going through the discussion questions after the simulation, be sensitive to the experiences of the students in your class, some of whom may be recent immigrants themselves or may move frequently from place to place within the country due to parents' job situations, foster care or other family issues. Be careful not to embarrass anyone — one of the points of the activity is to foster understanding for why so many people do migrate. Rather than focus the discussion on current immigration debate in the United States, you may want to place migrations of people in a historical context, such as the Irish potato famine or Eastern European Jews escaping the persecution of pogroms in the early 20th century.

Follow-up Activities:

1. As an individual or group project, have students explore and report on a large migration that occurred in history because of religious persecution, cultural warfare, labor shortages, food shortages, captivity/slavery, prolonged harsh weather, violence, prospect of riches, population pressures, etc. Many of these factors are related and overlap. Aim for variance between projects.

2. Have students interview someone who moved from another state or country. Explore that person's reasons for moving. Where are family members now? What was good about the move? What was most difficult? How does he/she view migration?

3. Invite a few guests into the classroom who can tell their migration stories, discuss their views and entertain questions from students.

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ACTIVITY 26

Educating Wanjiku

Concepts:
Status of women and treatment of girls affect population growth worldwide.

Objectives:
Students will be able to:
- Explain why girls in many less developed countries receive less education and other opportunities than boys do.
- Identify links between female literacy and status and population growth.
- Interpret graph data.

Subjects:
Social Studies, Language Arts

Skills:
Critical thinking, reading, brainstorming, interpreting graphs

Method:
In this activity students will learn about the status of women and girls in developing countries, and how it is related to population growth, by reading a short story on the education of girls in Kenya. Students will then answer discussion questions and interpret a graph. As a follow-up activity they can evaluate the status of women in the United States by discussing their heroes.

Introduction:

Ask students to imagine what it would be like if they were not allowed to go to school because of their gender. This is a reality for girls in many parts of the world, where, because of social, cultural and economic factors, women do not have the same choices and opportunities that men have. Of the 1.3 billion people in poverty, more than 70 percent are women. In addition, most of the 130 million children without access to primary school are girls.

The cycle of discrimination against women in developing countries begins with the treatment of girls. Many societies do not allow girls to go to school, and therefore girls have few opportunities for employment and economic freedom. In these cultures the main function of women is to have children and tend to household duties, so it is common for girls to marry and have children at an early age. In many of these cultures boys are preferred because they are the ones who will someday work and support their parents in old age. Daughters, on the other hand, are often viewed as economic burdens. When they marry, they move away to wait on husbands and husbands' families. Since female children are not as valued by the society, they often receive less food, medicine and education. In this way the cycle of discrimination continues.

Breaking this complex cycle and raising the status of women begins with making education equally available for girls and boys around the world. Studies show that women who can read have healthier children. They also tend to delay marriage and childbearing because they have other options like college and employment. There is a strong link between education and fertility; the more education women have, the more likely they are to have small families.

Women in different parts of the world face different struggles. In less developed countries women and girls are struggling for access to education, health care and employment outside the home. In the United States and other developed countries women have attained a much higher status and more opportunities in recent decades. Even so, women still struggle to earn an equal wage as men for equal work, and to be well represented by lawmakers. These struggles are similar because they are about increasing the options available to women. In recent years, people have begun to realize that discrimination against women has a negative impact on individuals, communities, societies and the environment.

It would seem that because girls and women make up 50% of the world's population that they would be in a position to influence and improve human well-

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being. However, the needs, the work and the voices of women around the world are often ignored. The key to a healthy planet includes social equality. Promoting the health, economic and educational status of the world's women will guarantee a better quality of life for all. In this activity students will think about the role education plays in elevating the status of women.

Materials:

Copies of the reading "*Why has Wanjiku dropped out of school?*" (one per student)
Copies of the Student Worksheet (one per student)
Paper
Pen or pencil

Procedure:

1. Copy the story "*Why has Wanjiku dropped out of school?*" and distribute it.

2. After students have completed the reading, have them answer the questions on the Student Worksheet. Discuss the answers as a class.

Follow-up Activity:

Who Are Your Heroes?

As a follow-up, students will consider the status of women in the United States. They will use the indicator of heroes to examine how our society values the contributions of men and women. The nature of this activity is subjective, so it is up to the facilitator to draw connections between students' own personal heroes and the traits and ideals that are valued by society as a whole.

Procedure:

1. Divide students into groups of three or four and assign each group a category from the list below.

2. Ask each group to brainstorm on a list of four famous figures or heroes in their category.

3. Have students answer the following questions about their heroes.

   a. How many of them are men? How many are women?

   b. If you have more of one gender than another hypothesize on why that is. (Example: If your political heroes are mostly men, it might be because more men hold political office.)

   c. What is it about your female heroes that you admire? (Is it intellectual ability, physical ability, physical beauty, other?)

   d. What is it about your male heroes that you admire?

   e. What do "heroes" tell us about culture or society as a whole?

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Categories of Heroes:

a. political heroes
b. religious heroes
c. sports heroes
d. music heroes
e. literary heroes
f. television/ movie heroes
g. personal heroes (family/friends)
h. model heroes
i. American history heroes
j. world history heroes

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Why has Wanjiku dropped out of school?

Educating Wanjiku

As Nyambura lowered her pail into the sun-dappled stream from which she fetched her family's water each morning, she heard a pure, high voice singing the old song about the maize flowers blooming all over Kenya. It was Wanjiku; the voice was unmistakable — and much missed in class now that her parents had pulled her out of school to help her mother at home after the birth of her latest brother. Nyambura didn't quite understand why they had done that; her own mother had just as much work as Wanjiku's. And it made her uncomfortable that she was still in school when Wanjiku wasn't. She set her pail down and ran up the path to greet her former classmate; she didn't want Wanjiku to feel that they weren't close friends just because they no longer saw each other daily.

"We got a new goat to go with my new brother," said Wanjiku as Nyambura took her hand.

"Which one is more troubling?" asked Nyambura, smiling.

"It's hard to tell. The goat, I guess. Yesterday it ate the sleeve of my red blouse."

They laughed together and, at the stream's edge, kicked off their sandals to cool their feet in the water.

"It's my little sister who's exciting," said Wanjiku. "She's beginning to talk. She still stumbles when she walks, but she chatters away. Just like me at her age, Mamma says."

Nyambura wondered if Wanjiku's baby sister would ever go to school. She tried to remember the proverb her mother had learned at the dressmaking centre where she had also learned to read a few years before. All the eight-year-old girl could recall, though, was that when she had asked if she should stay at home like Wanjiku, to help with the younger children and the other household chores, her mother had pulled her ears gently and said, "Not you, honeypot. With that head of yours, you're going to write the kind of books that taught me how to read."

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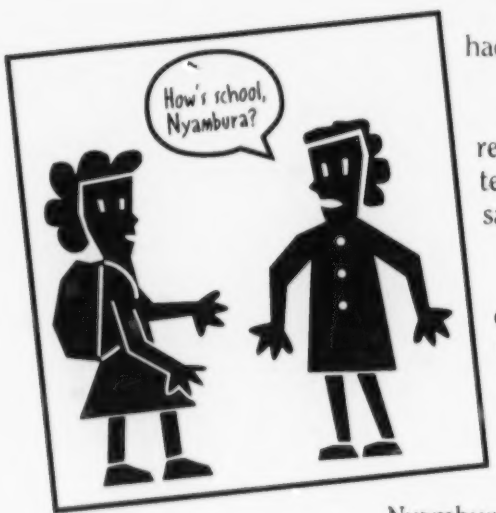
"And your father thinks the same," his voice had boomed suddenly in the doorway, "so don't go asking him such foolish things." He had entered the house, smiling, and threatened to tickle her to death if she raised the question again. That had closed the matter — for her at least. The problem, thought Nyambura, as she looked at her friend's rippled reflection in the water, was that Wanjiku's head was just as good as hers — different, but just as good. One of the reasons she missed Wanjiku so much in class was that her friend's answers to their teacher's questions often set off new thoughts in her own head. Had each made the other's head better?



And now Wanjiku was asking just the question Nyambura had been dreading: "What's going on at school?"

"We're learning division." she replied. "It's easy," she added, remembering how good Wanjiku had been at math. "I could teach it to you if you like." Suddenly she realized that she'd said something wrong.

"Of course it's easy," Wanjiku retorted. "Just the opposite of the times tables we were doing when I left. If five times two is ten, then two goes into ten five times." She stood up and filled her pail. "You know," she said, "I bet I can get my older brother to teach me everything he's learned in school. I don't really need to go myself."

Nyambura wondered, but she said nothing. That brother wasn't very interested in school — and he never seemed to have time for anyone but his friends. Then her mother's proverb came back to her: "Educate a boy and you educate one person; educate a girl and you educate a nation."

Reprinted with permission from *Girls: Challenging the World*, United Nations, 1995.

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Name: _____ Date: _____

"WHY HAS WANJIKU DROPPED OUT OF SCHOOL?"

Student Worksheet – Page 1 of 2

Part 1: Reading Comprehension

1. How old is Wanjiku?

2. Why did Wanjiku's parents take her out of school?

3. Why did Nyambura's mother decide to keep her in school?

4. What might the mother's proverb mean? "Educate a boy and you educate one person; educate a girl and you educate a nation." Do you agree with the mother? Why or why not?

5. How might Nyambura's future differ from Wanjiku's as a result of her having gone to school?

6. What kinds of choices will Wanjiku have when she is older if she never returns to school?

7. Which girl might get married first? Why?

8. Which girl might have children first? Why?

9. List two possible results of societies' denying girls education.

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Name: _____ Date: _____

"WHY HAS WANJIKU DROPPED OUT OF SCHOOL?"

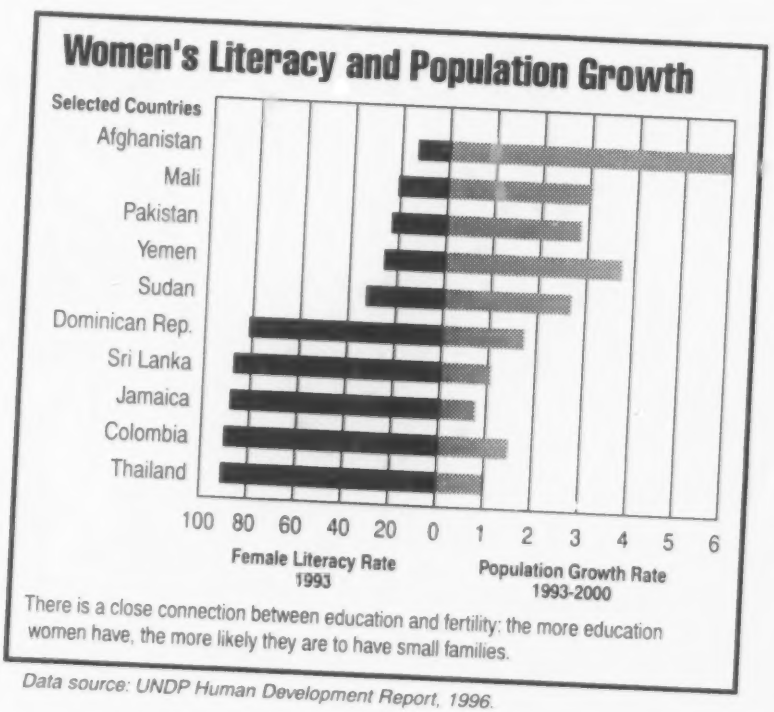
Student Worksheet – Page 2 of 2

Part 2: Graph Interpretation

1. On the graph below, which two countries have the highest female literacy rate?

2. Which country has the highest population growth rate?

3. What might be the relation or connection between the female literacy rate and the population growth rate?



Data source: UNDP Human Development Report, 1996.

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You and Your Community

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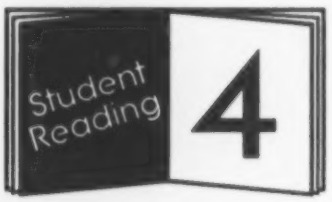
Your Place On The Planet



You may have heard the saying, "Think globally, act locally." What does this mean? In Part 3, we read about some of the problems that many members of our global family face around the world, such as poverty, hunger and **social injustice**. In Part 2, we read about some of the human threats to the global environment such as **deforestation**, loss of wildlife, air and water pollution and loss of topsoil to grow crops. These are all huge problems! What can one person do? How can any one person make a difference? The answer may be as close as your own backyard.

In thinking about how to make this world an even better place, we can start with our own communities — the towns, cities and neighborhoods where we live. Wherever you live, there are probably local concerns about quality of life for people and the environment. Maybe you've seen stories in your local papers or on TV about how land is being used, where garbage is put, whether the air and water are clean for people and wildlife, whether some people are homeless in your area, and whether the streets are safe.

As populations grow, the cities and suburbs in this country expand, often without planning. Houses, shopping areas, factories and highways often replace farmland and wilderness areas. Sometimes cities grow faster than local governments can provide basic services like new schools, busing and clean drinking water. People around the country are beginning to talk about how to make their communities more **sustainable**. A sustainable community is one that meets the basic needs of all its inhabitants without harming the ability of future generations to meet their needs as well. Such a community would have clean air and water, green space, thriving businesses, good transportation, low crime rates and other things that create a good quality of life. Building sustainable communities requires people to work together and plan ways to manage their areas' resources — cropland, forests, waterways — so that they are there for years to come.

On a personal level, each of us can help our communities by conserving resources such as water and energy when possible. The three Rs of waste management — reduce, reuse, recycle — can help keep our communities free of litter. In everything we do, we can evaluate how our lifestyle choices affect the global environment — especially if we think about everyone around us taking the same actions. We can also look around our communities and see what we would like to improve to

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make them better places to live for people of all ages. If you can spot a problem, then you have also found an opportunity — to make a difference in your own community.

Young people throughout the country have rolled up their sleeves and gotten busy — planting gardens and trees to beautify their towns, picking up litter from roadsides, volunteering time to tutor younger children and read to older people, helping to build playgrounds and much more — all to improve life in their communities. Many of these projects are organized by youth groups at churches and synagogues or with Scout troops, 4-H and ecology clubs at school. You could even be the one to suggest a community service project to your friends and get it started. Your efforts may even be recognized by the local media. If they write about your project, it might inspire others to get involved.

Another way to make a difference is to get involved in government — you don't have to be voting age to have your say at public meetings or to get your letters printed in the newspaper! Living in a democracy means that you can speak out about how you think life can be improved for you, your friends and family, and other people in your community. In fact, citizen action is one of the critical parts of our political system. One person can always influence many by writing a letter to the press or by speaking at meetings of clubs, student groups, school boards and city councils.

When you think about the future, ask yourself what you would like the world to be like for you, your family and friends, and the members of your global family. That's the first step in making the kinds of decisions that will help you achieve that future. Margaret Mead, a noted **anthropologist**, once said, "Never doubt that a small group of concerned citizens can change the world. Indeed, it is the only thing that ever has."

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Reading Comprehension and Analysis:

1. What is the definition of a sustainable community?

2. What are some things each of us can do on a personal level to improve our communities?

3. What types of projects can we do with others that work toward improving our communities?

4. What did Margaret Mead mean when she said, "Never doubt that a small group of concerned citizens can change the world. Indeed, it is the only thing that ever has." Can you think of examples from history where small groups of concerned citizens have changed the world in some way?

Glossary:

anthropologist: a social scientist who studies humans, especially our cultures and relationships to each other and to the environment.

deforestation: clearing land of forests.

social injustice: unfairness to individuals or groups.

sustainable community: a community that meets the needs of current inhabitants without harming the ability of future generations to meet their needs as well.

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ACTIVITY 27

Growing Pains In Texas Hill Country

Concepts:
Population growth is a factor in local debates about growth, development and the environment.

Objectives:
Students will be able to:
- Define urban sprawl.
- Identify three perspectives in local growth debates.
- Exercise problem-solving skills to propose solutions to growth issues.
- Use logic and argumentative skills in city council debate simulation.

Subjects:
Language Arts, Social Studies, Dramatic Arts, Science

Skills:
Critical thinking, reading, writing, role playing

Method:
Students will gain an understanding about the impact of population growth and urban sprawl on communities when they read an article about local growth, write a proposed solution and simulate a city council debate.

Introduction:

In discussing the impacts of population growth on society and the environment, we often focus on global examples and issues. However, the impacts of changes in population are felt most on the local level. In the United States, population growth comes up in issues of urban sprawl, development, sustainable community projects and a host of other local debates. In this exercise, students will read an article about growth in the Texas Hill Country, engage in a simulation that explores the complexities of growth debates and then synthesize their views in a persuasive writing exercise. Although the article included focuses on the specific details of the growth debate in central Texas, this debate is occurring across the country. Wherever possible, supplement this activity with local issues and debates.

Materials:

Paper
Copies of the article, *"Splendor vs. Sprawl"* (one per student)
Current local newspapers
Role-Playing Cards (provided)

Part 1: Reading All About It

Procedure:

Copy the article *"Splendor vs. Sprawl"* for each student.

1. Write the following definitions on the chalkboard to aid students' comprehension of the article.

   urban sprawl: Land use/development pattern in which the edges of the city grow outward into the surrounding rural or undeveloped areas.

   zoning laws: Local laws that divide a city into sections reserved for different purposes (as residence, business or manufacturing).

   aquifer: A porous and permeable underground formation that stores and transmits enough groundwater to supply wells. Many areas depend on aquifers as a major source of domestic and agricultural water.

2. Allow students time to read the article quietly.

3. Go over the following questions as a class.

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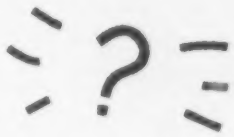
Comprehension Questions:



1. What are two factors that have contributed to the 18% population growth in the Texas Hill Country?

2. List two negative and two positive attributes of the population growth in the Hill Country.

3. What were some of the concerns of the residents?

4. List employment options for residents in the Hill Country. Which of these are new?

Critical Thinking Questions:

1. One woman estimated that 50% of the residents of Wimberley commute 50 miles to Austin daily. What are the environmental effects of this?

   More people driving means more air pollution. A need for more/wider roads can result in destruction of wildlife habitat.

2. In order to accommodate the growth, what are some things that these towns will need?

   Suggested answers include: More roads, more houses, more water, more jobs, more transportation.

3. What did Paul Scott Malone mean when he said, "We bring our urban ways here and before long, whatever it is that used to make our eyes shine when we said, 'the Hill Country' is going to be, 'Oh, what a shame.' "

   People are moving to the Hill Country to enjoy the benefits of a rural lifestyle, and yet as more people move there that lifestyle is threatened.

Part 2: Be It Resolved ...

Procedure:

Now students will have the opportunity to evaluate the different perspectives offered by the article and then write a position statement based on their opinions.

Have students follow up the reading by breaking into four groups and cooperatively writing resolutions for what a fictional Hill Country town should do about growth. The positions students offer should be well thought out and supported. The purpose of this exercise is not for students to look for the "correct" position, but rather for students to work on their persuasive writing skills.

Guidelines for writing resolutions:

Each resolution should be a short paragraph, with the first sentence proposing an action and the following sentences supporting why this action should be taken.

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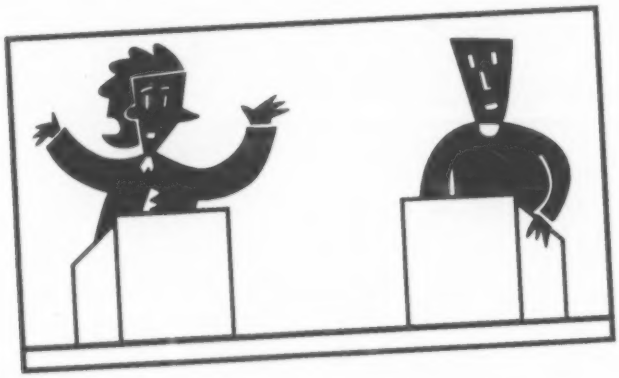
1. Ask yourself if you think that growth in your Hill Country town is a problem or an opportunity or some of both.

2. If you think it is an opportunity, pick one way that it will benefit the town and write a resolution to encourage growth for that reason.

3. If you think growth will create challenges for your town, pick one challenge and write a resolution that includes ideas for solutions.



Part 3: Debating the Hill Country's Future

Procedure:

In this section of the activity, students will have the opportunity to explore the complexities of the Hill Country growth debate, and to refine their logic and critical thinking skills while defending different positions in the debate.

In the following simulation, students act as residents of a small Hill Country town that has become increasingly more developed over the last ten years. As the *"Splendor vs. Sprawl"* article indicates, the growth has brought with it increased tourism, increased economic activity and an increased threat to the fragile ecosystems of the Hill Country.

1. Before embarking on the simulation you may want to have students learn/investigate the functioning of their own local government. Is there a mayor and city council, a board of trustees, a county executive or other?

2. Make a copy of the Role-Playing Cards master and cut up the cards. Give one card to each of eight students who will act as presenters. Assign five students to be on the city council (assign one of them to be the president.) Ask the remaining students to be residents of the town and to contribute their proposals and opinions after the initial presentations are made.

3. Explain the format of a local government meeting. Write the action statements of the four resolutions on the board. The city council president will call the meeting to order, and begin it by reading the four resolutions out loud. He/she will then call on each of the speakers to make their presenta-

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tions of five minutes or less, and will invite additional comments from the audience. Those wishing to speak should raise their hands, and then wait until the president calls on them. After hearing all of those who wish to speak, the members of the council will take a vote on each resolution.

4. Give students who have roles a few minutes to study their parts. Encourage students to supplement the information supplied in the role description with drama and imagination.

5. Conclude the simulation with a vote by the five council members on the four resolutions and a discussion on the outcome of the activity.

Follow-up Activity:

Have your students keep a scrapbook of newspaper and magazine clippings related to population growth or change. Related topics include: deforestation, wildlife/biodiversity, commercial and residential development, waste disposal, poverty, status of women, hunger and housing etc.

When the scrapbook is compiled, students can consider the following questions:

1. How does your community compare with the rest of the country or world in population trends and population-related problems?

2. How does population growth affect your community?

3. How does your community's land use affect other neighboring communities or others worldwide?

4. What are your community's most pressing problems? How is population related?

For general article critiques, offer students the following criteria:
(from *101 Ways to Use* U.S. News & World Report *in Your Classroom*)

- Does the headline accurately describe the event?
- Is the account based on fact or opinion?
- Are important facts detailed?
- Are several sides of a controversial issue discussed?
- How do photographs or illustrations contribute to the content of the article?

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GROWING PAINS IN TEXAS HILL COUNTRY

Role-Playing Cards

1. You are an elderly person who has lived in this town for 30 years.

When you first moved here it was a small sleepy town that came alive only on Saturdays when local farmers came in to shop. It was a quiet peaceful place. But since the population has been growing, it is no longer a quiet, peaceful place where you know all of your neighbors.

2. You are in your mid-twenties and you work in Austin, TX.

You just moved to this Hill Country town and you commute 50 miles each way in order to escape the city and enjoy the charm and quiet of this small community.

3. You work for the chamber of commerce.

Back in the 1970s the businesses in this town were not prospering. But now there are big new stores and shopping centers that stay open every evening and business is booming. The historic small town charm of your city has also attracted many tourists and that is creating new jobs. The sound of those cash registers is music to your ears, and you believe that everyone shares in the prosperity.

4. You own a local hardware store.

Growth has been good for you because new houses and more people have meant more business. However, you are becoming concerned because bigger businesses are starting to move into your town as well. Your sister, who owns a hardware store in Arkansas, said that when the national chain hardware store moved into her town it was able to offer cheaper prices and it could stay open later than a small business could. Your sister felt as if she were being run out of town. You wonder if this will happen to you.

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5. You are a biologist.

You know that as the population of your town grows water may be taken out from the Edward's Aquifer at a faster rate than it will be replaced. You also know that there is a greater risk of the aquifer becoming polluted, which would threaten the town's primary source of water. Finally, you know that as new roads and buildings are built, animals will be threatened by habitat loss.

6. You are a famous movie star.

You are considering building your latest house in this Hill Country town because you know that it is Hollywood's latest hot spot. Several of your famous friends have recently relocated there and they rave about the sparkling springs, the scenic hills and the charm this small town offers.

7. You are a rancher who has lived your entire life on your family's ranch.

Now because of the increase in property values, your taxes have increased and you no longer make a profit ranching. You know that your land is more valuable as real estate and you are considering selling to the developers. However, you are upset that it is no longer profitable to continue a livelihood that you have had your entire life.

8. You are a developer who purchased land on the edge of this Hill Country town.

Now that there is a strong demand, you want to build houses on it and then sell them at a profit. You want to begin building new houses that will be attractive and reasonably priced. They will enable many families to realize the American dream — a home of one's own in a pleasant community. Building the homes will also provide jobs for local workers for several years. The new homeowners will pay city property taxes averaging $500 a year and will shop at local businesses, thus helping the local economy.

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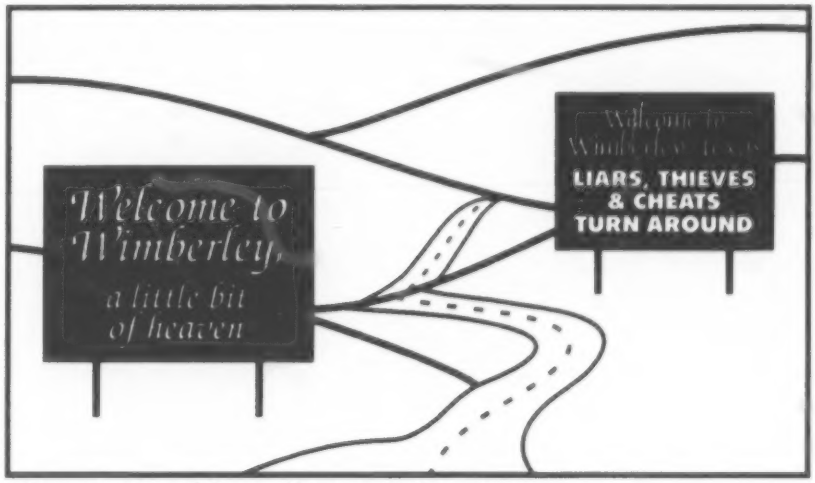
The Dallas Morning News

Sunday, September 10, 1995

SPLENDOR VS. SPRAWL

By Diane Jennings
Staff Writer of The Dallas Morning News



Welcome signs show a difference of opinion in Wimberley, Texas

Wimberley, Texas- Typical small town greeting signs dot the winding, two-lane roads leading to this Hill Country hamlet.

"Welcome to Wimberley, a little bit of heaven," reads one.

Another is not so friendly: "Welcome to Wimberley, Texas – Liars, Thieves and Cheats turn around."

The dueling signs reflect a sense of unease in the rolling hills of Central Texas.

After 150 years as a sparsely populated, primarily agricultural region, the Hill Country is being transformed by urban sprawl, and a shifting economy.

To survivors of the economic debacle of the '80s, the clatter of construction and the honking of horns is music to the ears. To others, who worry that growth will be the death of the Hill Country, the noise sounds like a funeral dirge.

"We are bringing our urban ways here," said Paul Scott Malone, a writer who has lived in Wimberley for seven years. "And before long, whatever it is that used to make our eyes shine when we said 'the Hill Country' is going to be, 'Oh, what a shame.'"

Although Mr. Malone rails against the growth engulfing his home, most are resigned to it.

"There's a growing understanding that it's inevitable the growth is going to happen," said local attorney Leslie M. Howe. "We can't take an ostrich approach. We must realize the time is here and now to deal with it."

Ms. Howe, president of the Wimberley Chamber of Commerce, has watched the population of Hays County grow by 18 percent since 1990. Wimberley is 50 miles from the state capital, and Ms. Howe estimates that as many as half of local residents commute to Austin.

The growth of Austin, at the edge of the Hill Country, has been spilling people into the picturesque countryside since the early '90s. The Austin metropolitan area has grown by about 12 percent, compared with statewide growth of more than 8 percent in the past five years.

A burgeoning retiree population also is fueling change across the Hill Country. For instance, a massive retirement community under construction is expected to more than double the population of Georgetown, a town of 15,000, in the next two decades.

Finally, tourism is changing small towns such as Fredericksburg. Once an agricultural market town, Fredericksburg is now heavily dependent on tourism, with the number of travel-related jobs in surrounding Gillespie County doubling from 1989 to 1993.

Not everyone thinks the change swamping the Hill Country will turn it into just another suburb.

"This is a classic example of urban America overwhelming agrarian America," said Dr. Lawrence Goodwyn, history professor at Duke University and author of *Coming to Terms: The German Hill Country of Texas*. But, he added, Hill Country folks "have a lot to lose, and they know that," he said. "They also have a lot of built-in resistance."

Although the region won't be what it was in the past or even what it is today in a hundred years from now, he said, "the Hill Country will be preserved as unique."

The Hill Country, extending from the western edge of Interstate 35, is the heart of Texas, literally and figuratively. Though not an officially designated area, the rolling hills encompass as many as 23 counties, depending on who's drawing the map.

Blessed with cool springs and clear rivers, breathtakingly beautiful when wildflowers swath its ridges and valleys, the Hill

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Country is the laid-back Texas that Waylon and Willie croon about in Luckenback, Texas.

Beneath the surface, however, the soil is thin and stony – the hardscrabble Texas that Lyndon Johnson rhapsodized over during his presidency.

When Texans wrested a living from the ground, the harsh land kept all but the hardiest farmers and ranchers at bay. Now, people are pouring into the area, not to make a living from the land, but to create a lifestyle on it.

Last year, for example, when someone asked longtime Hill Country ranch broker Marshall E. Kuykendall Sr. how many cows a certain ranch would support, "I had to stop and think, because I don't sell for that," he said. "The ranchers are not my buyers."

Cattle and sheep raisers, who dominated the Hill Country for more than a century, haven't been players in the market for years, because the land now is valued more for recreation than ranching, he said.

Prices vary widely, depending on how far the land is from urban areas, but they generally have doubled or tripled throughout the Hill Country since the early 1990s, Mr. Kuykendall said. Near Austin, prices have risen from $100-$1,500 an acre in the early '90s to as much as $4,500 today. Thirty miles west, toward Dripping Springs, prices range from $2,500 to $3,500 an acre, he said. Deeper into the Hill Country, in Kimble County, they cost $300 to $400 an acre.

When Mr. Malone and his wife, Cheryl, a reference librarian at the University of Texas, bought their home in Wimberley seven years ago, the area had a distinctly rural atmosphere, he said. "I'd drive downtown at lunch time and be the only truck on the road," he said.

Since 1993, he said, "It has been like the invasion of the urban mosquitoes." The invasion has been spurred in part by Austin's job growth. The Austin area has an unemployment rate projected at 3.5 percent for the rest of 1995, compared with 6.5 percent statewide, thanks largely to the growth of technology companies.

The population influx has choked the roads of Wimberley, and the growth has illuminated the previously black night sky with bright lights, Mr. Malone said.

The very thing we've all come out here to find is going to be lost to us," he said.

He applauded the grouchy billboard erected on the outskirts of town recently, because he fears newcomers don't share local values, such as respect for the land, he said.

The billboard was erected by longtime resident David Walsh, a local ranch manager, who paid more than $200 to erect his personal protest.

"It has been like the invasion of the urban mosquitoes."

"The issue is quality of life," Mr Walsh said. Though he would like to halt the growth, he admitted, "you can't stop it." The question is how to control the quality.

Ms. Howe, Wimberley's chamber president, said the town may have to incorporate, a move residents so far have resisted.

"They were reluctant to get more government in place – taxes and that sort of thing," she said, noting that many residents would like the town to "stay small and quaint and rural."

That reluctance to change makes it difficult to cope with Austin's urban sprawl, however. Currently, Wimberley has no zoning laws, leaving residents powerless to prevent someone from "putting a junk yard next to the school," Ms. Howe said. Or from erecting a billboard.

Also, there is no central water system.

"We have a very environmentally sensitive area," Ms. Howe said. "We have Cypress Creek and the Blanco River, which is the big buy for the tourists, but no centralized water. Everybody has a septic tank. These are issues that need to be dealt with."

Though rivers and springs abound in the Hill Country, the quality and quantity of water is a major concern, said Helen Ballew, executive director of the Hill Country Foundation, a conservation organization.

"I don't think we can populate the Hill Country to the degree that I think we see coming down the pike and have much of what we love about the Hill Country not be sacrificed in the process," Ms. Ballew said.

One of the area's main water sources, the Edward's Aquifer, lies under much of the rolling hills. The aquifer is particularly vulnerable to surface pollution, such as motor oil and pesticide runoff form urban areas, Ms. Ballew said. And as more people move in, the aquifer's ability to recharge itself diminishes.

The foundation recently published an "Eco Location" map that spotlights environmentally sensitive areas that it wants to spare from development. Ms. Ballew hopes to guide the inevitable growth to the I-35 corridor and points east.

But Ms. Howe said growth is not all bad.

Wimberley's scenery now includes not only spreading trees and swimming holes but an assortment of restaurants and retail stores jammed around a tiny square. The occasional strip shopping center houses law offices and dental practices.

"You can make a living in Wimberley now," she said. "I think a lot of people are happy about that... You don't have to go to Austin or go to San Marcos to get what you need. I think that benefit should foster a sense of community."

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ACTIVITY 28

In Search Of Sustainable Life

Concepts:
Planning for a quality future requires defining what "quality" means to all of us.

Objectives:
Students will be able to:
- ▶ Develop a quality of life index.
- ▶ Express their vision of a desirable community.
- ▶ Brainstorm factors important for a community's quality of life.
- ▶ Define the term "sustainable community."
- ▶ Research one indicator of quality of life in their community.
- ▶ Compare their community to one in a different country (optional).

Subjects:
Social Studies, Science

Skills:
Values identification, communication, brainstorming, visualization, decision making, prioritizing, critical thinking, problem solving, writing

Method:
Through class brainstorming and a cooperative learning activity, students develop an index of what they consider to be the ten most important indicators of a healthy community.

Introduction:

We all want to live in a community that not only contains all the resources we need to survive, but is also safe and clean and provides adequate services. Such a community is possible so long as we take responsibility for the overall quality of life affecting ourselves, our family, our friends and future generations. But how can we tell if our quality of life has improved or deteriorated?

Historically the government has used an economic index known as the gross national product (GNP) to measure progress. Recently the government has replaced GNP with GDP, the gross domestic product, which measures the value of all goods and services produced by U.S. labor and property. GDP is a good indicator of economic activity, but does not account for many social and environmental factors that influence quality of life. For example, the Exxon Valdez oil spill in Alaskan waters destroyed the habitat of countless fish, birds and other wildlife. Yet, the disaster actually added to the nation's GDP, since it provided jobs and required materials for the clean-up efforts. The World Resources Institute points out that a "country could sell off its timber and minerals, erode its soils, pollute its aquifers, deplete its fisheries and the national accounts would treat all the proceeds as current income." Suppose this happened. In the long-term, what would happen to our quality of life? You can see that economic activity does not tell the whole story. There are many indicators of quality of life that are not measured in economic terms, such as personal safety, natural beauty, clean air and water, peaceful neighborhoods and more.

The purpose of this activity is to let the students explore those factors that contribute to their community's quality of life and that many economists overlook in measuring our health and happiness — factors that address the concept of sustainability. A sustainable community is defined as one in which the needs of present generations are met without compromising the security of future generations. Together students will exchange ideas and develop a class "Quality of Life Index" with ten indicators. Each indicator can serve as a guidepost for their actions and for building stronger communities.

Materials:

Paper
Pencils

Procedure:

1. Write "Quality of Life Index" on the top of the chalkboard.

2. Introduce the major objective: to produce a usable index that measures sustainable quality of life. If you plan to send the class index in its final form

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to a city or state official, tell the students up front. Doing so generally sparks interest in the activity and a feeling of ownership of the class index itself.

Part 1: The One Thing I Would Like . . .

As a priming activity, have students share their responses to:

1. "The one thing I would like to add to or eliminate from my community that would make me happy would be. . . "

2. "The one thing I would like to add to or eliminate from my community that would benefit most of the residents would be. . . "

If time or class size permits, everyone should share. This allows students to think personally and to hear what their peers value. Resistance to this activity by some students is inevitable; be patient, yet firm. Students may "pass" with the understanding that they will eventually share after others have spoken. Ask for observations/impressions about what people said. How does the concept of quality of life relate to their responses?

Part 2: Brainstorming Indicators

Explain that in order to develop a quality index, we must first brainstorm possible indicators. Break the students into 5-7 cooperative learning groups. Each group should generate a list of factors that they think contribute to a community's lasting quality of life. Some of these may be the same as their answers in Part 1, but now they will be developing a much longer list of factors. In Part 1, students may have thought of specific things to add to the community (such as a movie theater or pizza parlor) or to eliminate from the community (such as gangs). Now they will be thinking in broader terms about the indicators/factors that make up a healthy community. Provide a specific example (such as amount of public park land, low crime rates or good libraries) and encourage students to likewise be specific. You should reasonably expect 15-20 factors, ranging from the most basic to the most absurd. Adhere to the basic brainstorm rule: focus on quantity. Check progress and plant seeds of thought as necessary.

After several minutes, stop the brainstorm. Some of the factors will be more important than others. Inform each group that they must devise a way to select and rank the seven most important indicators for a community's quality of life. You may want to suggest one or two approaches. Once students have a ranked list of seven, have one member from each group list their indicators on the board (perhaps in countdown style or one at a time so that students can compare results in stages). Expect overlapping responses. Conduct a class vote to determine the top ten indicators and rank them. Remind the students that an important quality of any indicator is measurability. You now have the ten indicators that make up the class index.

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Discussion Questions:

1. Do you think each of these indicators should carry the same weight?

2. How will you measure each indicator?

3. Would grouping these categories enhance the class index?

4. What name should the class index have?

Follow-up Activities:

1. Select one of the indicators for students to research for their own community. They should find out how to measure the indicator, what the status of that indicator is in their own community and what can be done to improve it.

   Example: If students select "crime" as one of the indicators, they could call the local police department to get statistics on the crime rate and how it is measured. They could also ask how this rate compares to that of neighboring communities. Has the crime rate gone up or down in recent years? Why might this be the case? Is crime a problem in and around schools? What are some proposals for making their area safer?

   Students can then outline their proposals for dealing with one of the indicators and send them to selected local leaders and government officials. They might also want to send the list of ten indicators they developed as a class, so that city officials can determine what students care about in their community.

2. If your social studies curriculum includes the study of different areas of the world, have students compare the quality of life in their community to one that has been studied in class in a different country. How are they similar and dissimilar? Have students write a one-page paper comparing the two communities.

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ACTIVITY 29

Take A Stand

Introduction:

Sometimes it is easier to think through an issue if you are asked to "take a stand" on it. For this activity, students are asked to take a position and articulate their views on several contemporary issues that are related to population and resource consumption trends.

Materials:

Signs reading: "Strongly Agree," "Agree," "?," "Disagree," "Strongly Disagree"
Masking tape

Procedure:

1. Tape the signs up on the wall around the classroom.

2. Explain to the students that you will be reading several statements to them, and that they should stand in front of the sign that most closely represents their reaction to the statement you've read. They will then be asked to explain their particular stand on each issue. They are free to move to a different sign if/when their opinions change after hearing their classmates' views.

3. When facilitating the activity, try to give equal time to representatives of different sides of the issue and solicit remarks from as many students as possible. Do not let your own opinions show, but you may pose questions to help students articulate their thoughts.

Note: Use your discretion in choosing statements that you feel students have enough information on to form an opinion and that fit best with your curriculum guidelines.

Statements:

1. As one of the richest countries in the world, the United States should welcome all those from other nations who wish to live here.

2. In an effort to feed a growing population, people in developed countries should drastically reduce the amount of meat they consume.

3. Arable land in the United States should not be used for housing, shopping centers or other urban uses.

4. In a real crunch, jobs are more important than environmental quality in the United States.

5. To reduce teen pregnancy in the United States, school health services should offer contraceptives to all students who want them.

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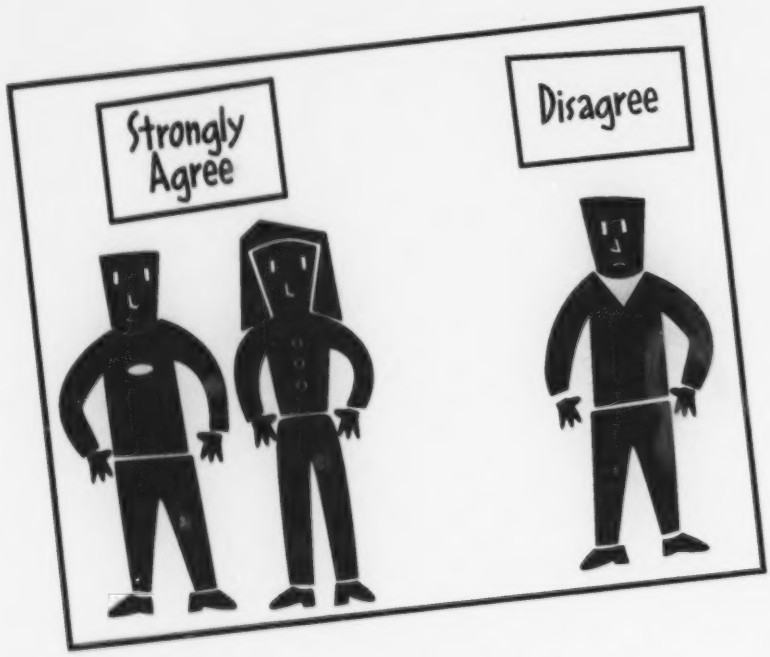
Concepts:
Dialogue and debate on ethical issues related to population and the environment are helpful in clarifying personal opinions.

Objectives:
Students will be able to:
▶ Articulate their thoughts on statements that deal with ethical issues about population and the environment.

Subjects:
Social Studies, Science, Language Arts, Family Life Education

Skills:
Values clarification, communication, discussion

Method:
Students articulate their thoughts about the ethical issues related to population and the environment, and consider the opinions of their classmates.



6. Any new construction or other project that may threaten the quality of America's drinking water should be prohibited.

7. Science and technology will certainly ensure that food production and energy supplies keep up with the demands of a growing population.

8. Americans should be required by law to separate their trash and recycle newspaper, glass and cans.

9. Endangered species' habitats should not be developed for any reason.

10. To lower our use of energy and levels of air pollution, we should spend more money on improving our public transportation systems than our highways.

Adapted with permission from *The Environment to Come: A Global Summary*, Population Reference Bureau, Washington, DC, 1983.

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Looking To The Future

ACTIVITY 30

Introduction:

It is valuable for students to think about what is possible, probable and preferable in their future lives. This activity is an excellent way to encourage futuristic thinking and also to determine whether students' thinking has changed as a result of what has been studied in class.

Materials

Paper
Pen/pencil for each student
"Dear Friend" assignment sheet (one per student)
Video camera (optional)

Part 1: My Hopes for the Future

Procedure:

During the first month of the school year, or at the beginning of an ecology unit, ask students to write five things they want for themselves 20 years from now and five things they want for the larger society in 20 years. Collect their responses and, as a class, tally the results. What were the most popular responses? Were there any common themes amongst the given answers? What are any obstacles to these hopes becoming reality in 20 years?

At the end of the school year (or unit), repeat the exercise, and again tally the results for the class. How do the results compare? In what ways do they differ?

Part 2: News and Views

Students can only make educated guesses about what might happen in the future if they are aware of what is happening in the present. This activity encourages students to regularly read news publications, to make connections between articles and topics covered in class, and to use their imaginations to visualize the challenges and possibilities of the future.

Procedure:

1. Have students collect news articles and opinion pieces on human population trends and related environmental and social issues. You may assign students a few specific subjects or have all students looking for all subjects. Subjects may include, but are not limited to, the following:

Air pollution
Community action and involvement
Endangered species
Food resources/hunger

Concepts:
Human behavior today will affect the quality of life in the future.

Objectives:
Students will be able to:
- ▶ Identify personal goals to be achieved in 20 years.
- ▶ Discuss potential impacts of current population trends on their future lives.
- ▶ Collect and summarize news articles about population and environmental trends.

Subjects:
Science, Social Studies, Language Arts, Family Life Education

Skills:
Summarizing articles, creative writing, visualization

Method:
In creating a futuristic news telecast and a letter to a friend 50 years from now, students think about what their future might look like, given current realities, hopes and dreams.

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Greenhouse effect/global climate change
Housing and homelessness
Immigration and emigration (out-migration)
Loss of forests
Mothers' and infants' health
Population growth
Population loss
Social security
Soil erosion
Waste disposal
Water pollution

Have students assemble a weekly "newsbriefs" bulletin board and/or a monthly newsletter summarizing population and environmental news. To facilitate the summarizing approach, students should write a one- or two-sentence summary of each article they bring in and submit it along with the article.

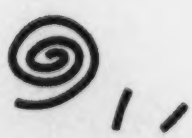
2. Have individuals or groups of 2-4 students use the topics from the present-day news articles they have collected to project how the future might be. Tell students to imagine they are working in a newsroom 40-50 years in the future. They must prepare a news telecast that includes news stories from the United States and around the world related to population and environmental trends. If possible, have students videotape their telecasts and air them to the class. Discuss why they chose their particular vision of the future. You may decide to assign the same topics to multiple groups in order to illustrate different possibilities and visions.

Part 3: A Look in the Crystal Ball

By sharing ideas about their future, students gain a clearer understanding of the hopes and concerns of their peers, better appreciate each other's similarities and differences and begin to actively plan for and imagine themselves in the future.

Procedure:

Tell students that you will be asking them several questions about their future during the class to spark discussion and begin to plan for the years ahead. After each question is asked, you will direct the question to a few random students who will then share their views and ideas. Emphasize that the exercise is most effective when they *visualize* life and conditions in the future based on what they think is really possible or probable. (It is sometimes necessary to guide discussion away from fantastic "neat-tech" views of the near future.)



As an alternative or follow-up activity, have students select one of the following questions to answer in an essay or story about the future:

How are students taught in 50 years?

What subjects do schools teach in 50 years?

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What hobbies do you have in 50 years?

What are the most common and most popular occupations?

Where is your favorite vacation spot and why?

What is your ideal mode of transportation? Is this what most people use?

What do rock concerts look like in 30 years?

You have created an award for companies — what will it be for?

What kind of person will be considered a hero or heroine 50 years from now?

What would you have liked to accomplish in 50 years? In 10 years?

What would you do with your life if you knew you could be healthy and live another 100 years?

What will be the most amazing invention after 50 years?

What has changed about food in 50 years?

What do you fear most about the future?

What do you look forward to the most about the future?

What are cities like 50 years from now? Do you live in one?

Part 4: Dear Friend

This creative writing exercise invites students to consider how continuing human population growth could affect their own lives in the future.

Procedure:

Duplicate the assignment sheet on the back of this page and distribute it to students. You may wish to suggest how long their letters should be.

Part 1 developed by Garland Johnson, Fresno Unified School District, Fresno, California.

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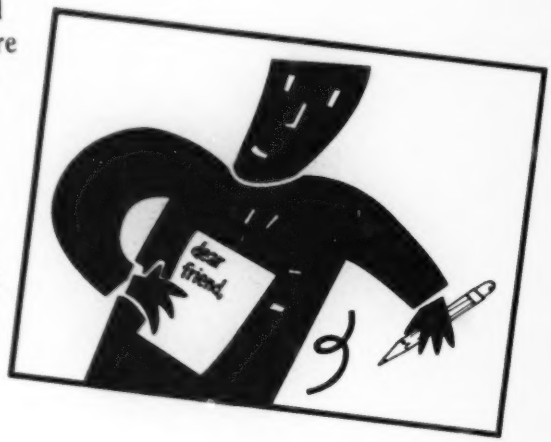
Name: _____ Date: _____

DEAR FRIEND
Assignment Sheet

If current rates of growth continue, the world's population will double in less than 50 years. Think about what this means for your own life. How might your life change with twice as many people in the world?

Write a letter, dated 50 years from today, to an old friend you haven't seen in many years, perhaps someone you are friendly with now. Talk about what is happening in your life and reflect on how things have changed in 50 years. What is better in your life? What is worse?



Some possible things to consider: Think about your neighborhood and places you like to go. How have they changed? How do people get around? What kind of work and activities do you do? Do you live near your friends and family members? What are you most happy about? What are you most afraid of?

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Glossary

The following vocabulary terms have been indicated in **bold** throughout the Student Readings.

anthropologist: a social scientist who studies humans, especially our cultures and relationships to each other and to the environment.

arable: refers to land that is able to be farmed.

billion: quite a large number (1,000,000,000). A billion is a thousand times as large as a million. It would take 95 years to count a billion dollars if you counted it eight hours each day at the rate of $1 each second.

biodiversity: the variety of species in nature and the genetic diversity within each species.

birth rates: the yearly number of births per 1,000 people.

carrying capacity: the number of people who can be supported at a sustainable level in an area with given resources and technology.

climatologist: scientists who study climates and their phenomena.

death rates: the yearly number of deaths per 1,000 people.

decompose: break down into smaller pieces.

deforestation: clearing land of forests.

emigrate: to leave one's country to live in another country.

erosion: the wearing away by water or wind.

exponential growth: a growth pattern where numbers double (multiplied by 2).

export: to send items to another country for sale or trade.

extinct: no longer existing. When a plant or animal species dies off, we say it is extinct.

fertile soil: soil that is rich in minerals and good for growing crops.

finite: limited amount.

finite system: a system of resources in limited supply. The resources can be reused or recycled (like water), but you can never make more. All matter is created from other matter already in the system.

fossil fuels: nonrenewable energy sources found beneath the surface of the Earth (oil, natural gas and coal).

gender: male or female.

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illiterate: unable to read.

import: to receive items from another country to buy or trade.

Industrial Revolution: a period in history (mid-18th century through the 19th century) when there was a surge of new technological advances.

infant mortality: the annual number of deaths to infants under one year of age per 1,000 live births in a given year.

less developed countries: poorer countries that do not manufacture as many of their goods as more developed countries.

life expectancy: the average number of years someone is expected to live based on current health trends.

malnourished: receiving less than the minimum amount of food for good health and growth.

megacities: cities with populations of 10 million or more.

migrate: to move from one place to another.

more developed countries: countries with greater overall wealth. These countries tend to be more industrialized, bringing in money from manufacturing more goods.

natural resources: raw materials supplied by nature.

nonrenewable resources: a resource from the Earth in a limited supply that cannot be regenerated, such as a mineral.

persecution: causing people to suffer because of their beliefs or origin.

population: the number of people in a country or region.

sanitation: the prevention of disease and promotion of good hygiene by maintaining clean conditions and safe drinking water.

social injustice: unfairness to individuals or groups.

status: position or rank in relation to others.

sustain: to prolong or maintain.

sustainable community: a community that meets the needs of current inhabitants without harming the ability of future generations to meet their needs as well.

zero population growth: when a population is stable, neither growing nor decreasing. Globally, this would occur when the birth rate and the death rate are the same.

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PEOPLE AND THE PLANET:
Sources for Further Research

There are many good resources available from private and public organizations to help teachers and students continue their research on the topics covered in *People and the Planet*. The following list identifies selected, national and international organizations which offer background information and classroom activities for particular population, environmental and development issues.

Air Pollution and Global Warming

Air and Waste Management
1 Gateway Center
3rd Floor
Pittsburgh, PA 15222
(412) 232-3444
http://www.awma.org

Union of Concerned Scientists
2 Brattle Square
Cambridge, MA 02238
(617) 547-5552
http://www.ucsusa.org

Biodiversity/Wildlife Issues

Department of Interior
United States Fish and Wildlife Service
1849 C Street, NW
Washington, DC 20240
(202) 208-5634
http://www.fws.gov

National Audubon Society
700 Broadway
New York, NY 10003
(212) 979-3183
http://www.audubon.org/audubon

National Wildlife Federation
8925 Leesburg Pike
Vienna, VA 22184
(800) 822-9919
http://www.nwf.org/nwf

Project WILD
5430 Grosvenor Lane
Suite 230
Bethesda, MD 20814
(301) 493-5447
http://eelink.umich.edu\wild\

World Wildlife Fund
1250 24th Street, NW
Suite 500
Washington, DC 20037
(202) 293-4800
http://www.wwf.org

Energy Use

The Alliance to Save Energy
1200 18th Street, NW
Suite 900
Washington, DC 20036
(202) 857-0666
info@ase.org
http://www.ase.org

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue, NW
Suite 801
Washington, DC 20036
(202) 429-8873
crest.org/aceee

National Energy Information Center
Energy Information Administration EI-231
Room 1F-048, Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585
(202) 586-8800
http://www.eia.doe.gov

Food Distribution and Hunger

Bread for the World, Inc.
1100 Wayne Avenue
Suite 1000
Silver Spring, MD 20910
(301) 608-2400
http://www.bread.org

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Food For All, Inc.
112 East Olive Avenue
PO Box 1791
Redlands, CA 92373
(909) 792-6638
foodforall@aol.com

International Food Information Council
1100 Connecticut Avenue, NW
Suite 430
Washington, DC 20036
(202) 296-6540
http://www.ificinfo.health.org

OXFAM America
26 West Street
Boston, MA 02111
(617) 482-1211
oxfamus@igc.apc.org

U.S. National Committee for World Food Day
1001 22nd Street, NW
Washington, DC 20437
(202) 653-2404
http://www.arachnid.GSU.EDU/~dcedsh/wfd

Forests

American Forestry Association
Global ReLeaf
1516 P Street, NW
Washington, DC 20005
(202) 667-3300
http://www.amfor.org

American Forest Foundation
Project Learning Tree
1111 19th Street, NW
Suite 780
Washington, DC 20036
(202) 463-2462
http://www.nceet.snre.umich.edu/plt.html

Rainforest Alliance
65 Bleecker Street
New York, NY 10012
(212) 677-1900
http://www.rainforest-alliance.org

Rainforest Foundation
270 Lafayette Street
Suite 1107
New York, NY 10012
(212) 431-9098
rffny@frrny.org

Temperate Forest Foundation
14780 SW Osprey Drive
Suite 355
Beaverton, OR 97007
(503) 579-6762
forestinfo@easystreet.com
http://www.forestinfo.org

Global Issues/Development Education

Academy for Educational Development
1875 Connecticut Avenue, NW
Washington, DC 20009
(202) 884-8000
http://www.aed.org

American Forum for Global Education
120 Wall Street
Suite 2600
New York, NY 10005
(212) 742-8232
globed@igc.org
http://www.globed.org

The Center for Teaching International Relations
University of Denver
2199 South University Boulevard
Denver, CO 8028
(303) 871-2164

Peace Corps – World Wise Schools Program
1990 K Street, NW
Washington, DC 20526
(202) 606-3294
http://www.peacecorps.gov

World Vision Canada
Development Education Department
Box 2500
Mississauga, Ontario
L5M 2H2 Canada

Migration

Choices for the 21st Century Education Project
Watson Institute for International Studies
Brown University
Box 1948
Providence, RI 02912
(401) 863-3155
choices@brown.edu

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National Immigration Forum
220 I Street, NE
Suite 220
Washington, DC 20002
(202) 544-0004
davidimf@aol.com

United States Committee for Refugees (USCR)
1717 Massachusetts Avenue, NW
Suite 701
Washington, DC 20036
(202) 347-3507
isra@isra/uscr.org

Mining, Raw Materials

Mineral Policy Center
1612 K Street, N.W.
Suite 808
Washington, DC 20006
(202) 887-1872
mpc-us@msn.com

National Mining Association
1130 17th Street, NW
Washington, DC 20036
(202) 463-2225

Population Dynamics

Population Reference Bureau
1875 Connecticut Avenue, NW
Suite 520
Washington, DC 20009
(202) 483-1100
popref@prb.org
http://www.prb.org/prb/

The World Bank
1818 H Street, NW
Washington, DC 20433
(202) 477-1234
http://www.worldbank.org

Zero Population Growth, Inc.
1400 16th Street, NW
Suite 320
Washington, DC 20036
zpgpoped@igc.apc.org
http://www.zpg.org

Sustainability, Conservation

Conservation International
1015 18th Street, NW
Suite 1000
Washington, DC 20036
(202) 429-5660
http://www.conservation.org

Izaak Walton League
707 Conservation Lane
Gaithersburg, MD 20878
(301) 548-0150
general@iwla.org
http://www.iwla.org/iwla/

The Nature Conservancy
1815 North Lynn Street
Arlington, VA 22209
(800) 628-6860
http://www.tnc.org

World Resources Institute
1709 New York Avenue, NW
Washington, DC 20006
(202) 638-6300
http://www.wri.org

Waste Disposal, Recycling

American Plastics Council
1275 K Street, NW
Suite 400
Washington, DC 20005
(202) 371-5319
http://www.plasticsresource.com

Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-2080
http://www.epa.gov

Keep America Beautiful, Inc.
1010 Washington Boulevard
Stamford, CT 06901
(203) 323-8987
http://www.kab.org

Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902
(423) 632-2101

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Water Resources

Clean Water Fund
1320 18th Street, NW
Washington, DC 20036
(202) 457-0336
cwa@essential.org

The Cousteau Society, Inc.
870 Greenbrier Circle
Suite 402
Chesapeake, VA 23320
(804) 523-9335
tcsza@igc.apc.org

Global Rivers Environmental Education Network (GREEN)
721 East Huron
Ann Arbor, MI 48104
(313) 761-8142
green@green.org
http://www.econet.apc.org/green/

Project WET (The Watercourse)
201 Culbertson Hall
Montana State University
Bozeman, MT 59717
(406) 994-1917

Soil and Water Conservation Society
7515 Northeast Ankeny Road
Ankeny, Iowa 50021
(800) THE-SOIL
swcs@netins.net

Women's Status

The Centre for Development and Population Activities
1717 Massachusetts Avenue, NW
Suite 202
Washington, DC 20036
(202) 667-1142
e-mail@cedpa.org

International Center for Research on Women
1717 Massachusetts Avenue, NW
Suite 302
Washington, DC 20036
(202) 797-0007
icrw@igc.apc.org

International Women's Tribune Center
777 UN Plaza
New York, NY 10017
(212) 687-8633
iwtc@igc.apc.org

United Nations Development Programme
1 UN Plaza
New York, NY 10017
(212) 906-5000
http://www.undp.org

United Nations Population Fund
220 East 42nd Street
New York, NY 10017
(212) 297-5000

Multi-issue Environmental Organizations

Friends of the Earth
1025 Vermont Avenue, NW
3rd Floor
Washington, DC 20005
(202) 783-7400
foedc@igc.apc.org
http://www.foe.org

Sierra Club
85 Second Street
2nd Floor
San Francisco, CA 94105
(415) 977-5500
information@sierraclub.org
http://www.sierraclub.org

Worldwatch Institute
1776 Massachusetts Avenue, NW
Washington, DC 20036
(202) 452-1999
http://www.worldwatch.org

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ZPG POPULATION EDUCATION MATERIALS

Counting on People: Elementary Population and Environmental Activities (for grades 1-6)

ZPG's elementary teaching kit, *Counting on People,* offers a wide variety of hands-on classroom activities for younger students. Population and environmental concepts are presented in fun, interesting ways so that even the very young can understand them. Students plant seeds and see how they grow, simulate cougars in the wild looking for food, conduct a census and hone their problem-solving skills as they learn about population-related concepts such as cooperation, sharing, conservation and family tradition. Includes over 30 hands-on activities plus memorable poems, songs and stories. #ELMN $19.95.

Earth Matters: Studies for Our Global Future (for grades 9-12)

ZPG's most comprehensive kit! This spiral-bound book of 12 student readings and 32 innovative activities covers such topics as deforestation, global warming, hunger, poverty and the status of women. *Earth Matters* also examines the under-lying clashes between economic growth and environmental health. Activities include simulations, debates, lab experiments, critical thinking exercises, problem-solving challenges and a rainforest board game. Received the highest rating of environmental kits about human communities from the California Department of Education and the California Energy Commission! #EMTT $19.95.

Multiplying People, Dividing Resources: A Math Activities Kit (for grades 5-10)

Math has never been so fun and eye-opening as with this kit of activities that make critical connections between people, resources and the environment. Now students can use real-world population and environmental data to practice working with large numbers, percentages, ratios and growth curves in analyzing the world around them. All of the activities are consistent with the goals of the new standards of the National Council of Teachers of Mathematics. Each kit contains 19 hands-on math activities, a World Population Data Sheet and ZPG's guide, *Computer Software for Population Education.* #MATH $9.95.

People and the Planet: Lessons for a Sustainable Future (for grades 5-10)

A must for the middle school classroom, *People and the Planet* helps students understand their relationship to the natural environment and to other members of our global family. Through 30 interdisciplinary activities and four readings, students explore population growth and resource consumption trends, and how these trends affect our ability to ensure environmental quality and social equality for all who share our world. *People and the Planet* also inspires students to be problem solvers and to consider the importance of community sustainability. #PPLN $19.95.

World Population (video for all grade levels)

Educators agree that *World Population* is the best-ever simulation of human population growth. As the years roll by on a digital clock from 1 A.D. to 2020, dots light up on a world map to represent millions of people added to the population. Historic references on the screen place population changes in context. This 6 1/2 minute video-cassette includes a 12-page activity and discussion guide, including a Spanish translation of the video's narration. "The impact of this short video is astounding," writes The *American Biology Teacher.* "It will be a valuable asset to any school's audio-visual library." #WPPV $29.95.

Selected Resources on Population

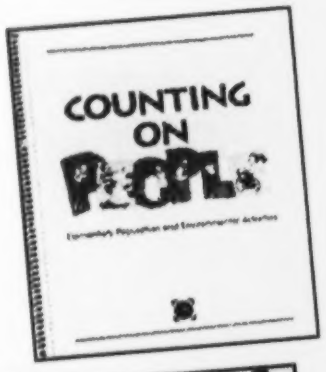
This comprehensive bibliography of information sources related to population and the environment includes books, bulletins, software, films and teaching materials. #SLCT $1.25.

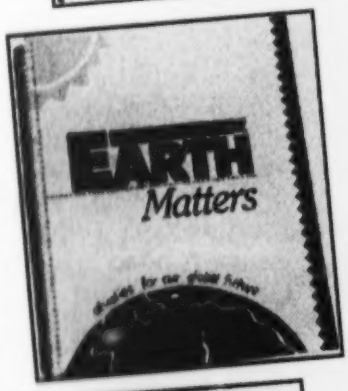
Actividades para Educación sobre Población (for all grade levels)

To meet the needs of classrooms in Latin America and bilingual classes in the United States, ZPG offer seven of its most popular teaching activities translated into Spanish. The motivational activities include simulations, games, problem-solving challenges, a quiz, riddles and a discussion guide to ZPG's dramatic video, *World Population.* #SPAN FREE.

Teachers' PET Term Paper (for all grades)

Lively quarterly newsletter for teachers involved in K-12 population education. Features student activities and reviews of books, audiovisuals, software and curricula. #TCHR $3.00 for one-year subscription.





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GREAT FOR YOUNG PEOPLE

Teen PACK (Population Awareness Campaign Kit) (for grades 7-12)

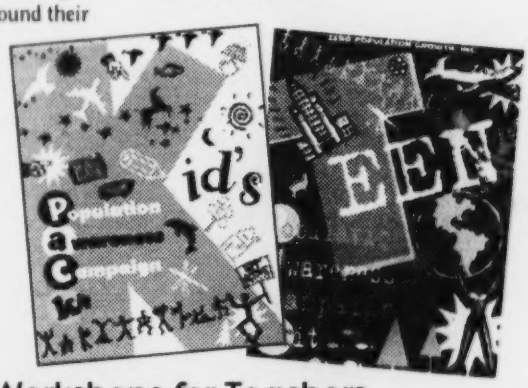
Get teens talking about the links between human population growth and environmental well-being with this information and action kit. Contains everything from letter writing tips to global simulation games for use in youth groups and ecology clubs. Introduces other teen "eco-heroes" and teaches how to start a petition campaign. Provides background information and topics for research papers. *Teen PACK* is intended for the individual and adaptable for the classroom. #TPAC FREE

Kid's PACK (Population Awareness Campaign Kit) (for grades 3-6)

Entertain and inform children on environmental and population issues through stories, games and concrete ideas for making a difference. Students write their own booklets on their "place on the planet," observe the effects of crowding in a home gardening activity and "catch" pollution around their neighborhoods. Children learn how to use the "power of the pen" to write persuasive letters. *Kid's PACKs* even include zany stickers, brain-teasing word games and a pull-out poster of "Amazing Eco Facts and Figures." #KPAC FREE

Popular Planet Press (for ages 8-12)

This children's newsletter includes articles, fun facts, games and "tales from the people planet" to show kids the links between population growth and our environment. Published three times each year, *Popular Planet Press* welcomes submissions from children. #PPPP FREE



ZPG Population Education Training Workshops for Teachers

ZPG offers population education training workshops through inservice programs and teacher education programs throughout the country. Since 1975, thousands of educators have participated in these workshops, and millions of young people have benefitted from population studies as a result.

Population education helps students appreciate the interdependence of people, natural resources, food, industry and land. They learn not only about the social, political and environmental impacts of population growth and change, but more importantly, how their own personal decisions will affect the quality of life in tomorrow's world.

ZPG workshops present current information on world and U.S. population trends and their impacts and demonstrate a variety of teaching strategies designed to actively involve students in the learning process: videos, games, quizzes, simulations and other thought-provoking exercises. Workshop participants receive complimentary teaching materials to support their population education efforts: current population statistics, scripts for classroom activities, resource lists and reference guides. They also receive follow-up assistance through a quarterly newsletter, phone contacts and correspondence.

Workshop length and content are tailored to the professional needs of the participants. Some are as short as an hour, others as long as a full day. Some are geared toward a specified audience (e.g., high school social studies educators, middle school life science teachers or elementary school teachers); others are open to teachers of all subjects in grades K-12.

For further information, or to arrange a ZPG population education workshop, contact:

ZPG Population Education Program
1400 16th Street, N.W., Suite 320 • Washington, DC 20036
Phone: (202) 332-2200
e-mail: zpgpoped@igc.apc.org

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People and the PLANET:

Lessons for a Sustainable Future

In our increasingly interdependent world, *People and the Planet* is a must for the middle school classroom. It helps students to understand their relationship to the natural environment and to other members of the global family. As an interdisciplinary, environmental education and global studies activity guide in one, *People and the Planet* covers concepts and objectives central to science, social studies, math and family life education. Through 30 hands-on (and minds-on!) activities and four readings, students explore the interconnections of human population growth, natural resource use, solid waste management, biodiversity, social justice and community well-being. *People and the Planet* also inspires students to be problem solvers and to "think globally and act locally."

HERE'S A SAMPLE OF THE MEMORABLE ACTIVITIES INSIDE:

- ❑ **Seeing Double...** How do populations grow? Set up a simple fruit fly lab and let students observe the swift multiplication.
- ❑ **Food for Thought...** Students "populate" major world regions, observe disparities of population, wealth, arable land and diet, and experience the social and political problems that result.
- ❑ **A World of Difference...** Students "spill the beans" on biodiversity and ponder the "What Ifs?" of losing any of the threads in our complex web of life.
- ❑ **Transportation Tally...** Study the automobile's impact on air quality, open space and energy consumption with these eye-opening word problems.
- ❑ **Growing Pains in Texas Hill Country...** Take part in a real-life debate over local growth issues and community well-being.
- ❑ **Educating Wanjiku...** Read about why many girls around the world lack education, and how this affects our global society.

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